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Integrating Commodity and Conservation Programs

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Roger Claassen, Marcel Aillery, and Cynthia Nickerson

Abstract

Can a single program support farm income and encourage producers to adopt environmentally sound farming practices? While simple in concept, attempting to roll the farm income support features of existing commodity programs and conservation payments into a single program raises questions. Exactly how would farm commodity and conservation payments be combined? What difference would it make for environmental gain and farm income support? This report approaches the questions in two ways. First, spending patterns in existing commodity and conservation programs are analyzed to determine the extent to which producers who are currently receiving commodity payments also receive conservation payments. Then, a number of hypothetical program scenarios are devised and analyzed to estimate how emphasis on current income support recipients would differ from a combined program that focuses on achieving cost-effective environmental gain. The results show that policymakers face significant tradeoffs between environmental (conservation) objectives and farm income support objectives in designing a program that provides both income support and environmental gain.

Keywords: conservation, commodity programs, income support

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Summary

Conservation and commodity programs have many advocates and beneficiaries. Commodity programs support farm families in an effort to ensure abundant supplies of crop commodities; conservation programs encourage stewardship of natural resources and the environment. Can these two aspects of U.S. agricultural policy be joined together into a single, integrated approach to farm support and conservation? Under this hybrid approach, agricultural producers receiving commodity payments would also work to improve their environmental performance (and vice versa)—an appealing quid pro quo. But there is a catch—an integrated program will be effective in achieving both conservation and commodity program goals only if those producers who receive existing commodity payments also face pressing environmental needs.

What Is the Issue?

Policymakers may need to compromise commodity program objectives, conservation objectives, or both, in merging conservation and farm commodity payments into an integrated "green payments" program.

This report:

- examines the extent to which participation in existing conservation and commodity programs overlap
- devises a set of hypothetical scenarios covering a wide range of possible green payment program designs
- analyzes likely producer reactions and the resulting environmental and income support outcomes for each of these scenarios.

What Did the Study Find?

Policymakers may face significant tradeoffs if they attempt to combine farm commodity and conservation payments. Commodity payments are intended to support farm families while ensuring abundant supplies of crop commodities at competitive market prices. These goals are quite distinct in scope and emphasis from those of conservation programs, which are designed to promote environmentally sound farming practices. Many farms that receive existing conservation payments or offer opportunities for cost-effective conservation do not receive payments from existing commodity programs.

In 2004, only a small proportion of U.S. farms (6 percent) received payments from both commodity and conservation programs, partly because conservation programs have been small relative to commodity programs. Because conservation program budgets and payments are increasing, however, the overlap between commodity and conservation payments is likely to increase. Nonetheless, only 43 percent of conservation program payments in 2004 went to farms that also received commodity program payments. This suggests that a significant share of new conservation payments could go to farms that currently do not receive commodity payments.

Conservation and farm commodity payments could be combined in many ways. In devising hypothetical scenarios, we consider variations on two general approaches—environmental compliance and environmental performance. The approaches are selected to help identify and characterize possible tradeoffs between conservation and the farm income support features of existing commodity programs in designing an integrated program, as follows:

Environmental Compliance. Policymakers could start with existing commodity programs and make them "greener" by adding environmental compliance requirements. While the new requirements could result in greater conservation effort by commodity payment recipients, producers' additional conservation costs would cut into income support. Moreover, current farm commodity payments reach only about 25 percent of U.S. farms, although those farms control about 80 percent of cropland and 50 percent of all agricultural land. The other 75 percent of farms and ranches, including many with pressing environmental needs, are not eligible for payments because they do not produce program crops.

Environmental Performance. On the other hand, policymakers could start from a conservation program perspective, devising a set of conservation payments that could exceed producers' conservation costs and, therefore, support farm income. One way to do that is to offer payments that are commensurate with environmental performance rather than cost. To the extent that payments exceed cost, producers could make a "profit" on producing environmental gains. Because program eligibility would not be confined to farms that receive commodity payments, however, income support and conservation effort would be spread more broadly across the farm sector than for the environmental compliance scenarios. If policymakers decide to offer an integrated green payment program in lieu of existing commodity programs (rather than in addition to these programs), current recipients of commodity payments could realize a loss in net income support.

Empirical analysis shows both similarities—and significant differences—across the hypothetical scenarios. In general, we estimate that:

- **Both environmental compliance and environmental performance scenarios deliver both environmental gain and income support.** While neither approach assumes any specific funding levels for income support or conservation, both can produce substantial income support and environmental gain. Depending on the specific scenario, conservation expenditures account for as much as 50 percent of total payments to producers. The balance of the total payment (total payment less net conservation expenditures) is income support.

- **Environmental gain depends critically on program design.** While both environmental compliance and environmental performance scenarios leverage environmental gain, the environmental performance scenarios realize gains at a lower cost per unit of environmental gain. In other words, environmental performance scenarios are more cost-effective than the environmental compliance scenarios in producing environmental gain. More cost-effective environmental gain means that a given budget can produce more environmental gain, more income support, or both.

- **Policymakers may face a difficult tradeoff between environmental gain and the *distribution* of income support.** Cost-effective environmental gains are achieved largely by encouraging the enrollment of producers who can deliver large environmental gains per dollar of cost. These producers, however, are not necessarily those historically receiving commodity program payments. If policymakers want to continue supporting recipients of existing commodity program payments, they are likely to face a difficult tradeoff between environmental gain and income support.

How Was the Study Conducted?

Analysis of existing commodity and conservation payments is based on Agricultural Resources Management Survey (ARMS) data for 2004. To analyze the hypothetical program scenarios, the authors developed a model based on the ARMS farm business and household survey for 2002. Data from 2002 are used because it is the most recent year for which grazing land acreage is provided. Additional data on conservation treatment needs (e.g., whether soil erosion, nutrient runoff, etc., are problems) and the potential for environmental gains were also used. Data sources include the National Resources Inventory and the Workload Assessment data, both maintained by USDA's Natural Resources Conservation Service (NRCS). To quantify environmental gain, we used an environmental index, similar to the Environmental Benefits Index used in the U.S. Department of Agriculture's Conservation Reserve Program. Producers were assumed to participate if payments exceed the minimum payment they would accept for undertaking a given treatment or set of treatments. The payment needed to make farmers willing to adopt specific treatments was estimated from NRCS Environmental Quality Incentives Program data.

Supporting Farm Income and the Environment: Can a Single Program Do Both?

Can a single program provide income support similar to existing commodity programs and improve the environmental performance of U.S. farms? An integrated “green payment” program would attempt to do both—combining key elements of existing farm commodity and agricultural conservation programs. Although the idea is not exactly new—some existing programs do support income and encourage better environmental performance—most programs focus on commodity support or conservation and have a secondary or limited effect on the other. Existing farm commodity programs, for example, are intended to support farm families historically involved in the production of major field crops, but also link payments to environmental compliance requirements. To maintain eligibility for commodity program payments, producers must apply approved conservation systems on highly erodible cropland and refrain from draining wetlands for crop production. Perhaps the best existing example of a conservation program that also provides income support is the Conservation Security Program (CSP), administered by USDA’s Natural Resources Conservation Service. Producers can receive “stewardship” payments based on past conservation efforts rather than current conservation costs. While only about 15 percent of program funds are devoted to stewardship payments, these payments could enhance farm income because they are not tied to the cost of adopting or maintaining conservation practices.

A more complete merger of the income support features of existing commodity programs and conservation payments—an integrated “green payment” program—could be pursued for a variety of reasons. As the importance of conservation programs in overall U.S. farm policy rises, for instance, green payments could be seen as a way to harness commodity program payments for environmental gain. One way to do that would be to raise the bar on environmental compliance. Additional compliance requirements could include soil conservation (on cropland that is not considered highly erodible), nutrient management, or pest management. With this approach, a green payment program would continue to focus on traditional recipients of commodity program payments.

Environmental performance or stewardship could also be seen as a primary basis for farm program payments. At present, about 25 percent of U.S. producers receive commodity program payments; these producers account for more than 80 percent of cropland and 65 percent of crop production (by value). If producer payments were based, instead, on some measure of environmental performance, income support could be available to a broader range of producers and could leverage a broader range of environmental gains when compared to an expansion of compliance requirements for traditional commodity programs.

Can green payments be an effective mechanism for delivering both income support and environmental gain? Because green payments, as we use the term in this report, would join two important aspects of U.S. agricultural policy, it is tempting to view them as a “win-win” proposition, perhaps

The Many Shades Of Green

The term "green payment" has been used in a number of different contexts to mean different things. As we use the term, a green payment is based on a (relatively) co-equal consideration of both income support and conservation (environmental) objectives. Many individuals and organizations concerned about farm policy in general and agricultural conservation policy in particular also use the term in this way. Others, however, view green payments as referring to any conservation or environmental payment, regardless of its relationship to income objectives. We refer to these as conservation payments. Still others view green payments as agricultural payments of any type that meet the criteria for inclusion in the World Trade Organization (WTO) "green box." In this context, being green isn't about environmental performance. Policies end up in the WTO green box if they have little or no impact on commodity prices or trade. These programs are given the *green light* to go forward under WTO rules, but are not considered within our usage unless they provide both income support and conservation assistance to farms.

increasing support of agricultural policy or even saving money. Inevitably, however, tradeoffs will arise. The portion of a green payment that producers use to pay conservation costs (e.g., adopting and maintaining conservation practices) will not support farm income. Income will be supported only to the extent that payments exceed conservation costs. The proportion of payments that would be used for conservation as opposed to income support is an important issue in green payment design.

An equally important question is whether farms that receive income support under existing commodity programs can also make cost-effective contributions to improving environmental quality. If farms historically eligible for commodity program payments would not otherwise be targeted for conservation payments, prioritizing farms for green payments could involve compromising income support objectives, conservation objectives, or both. While most farms could address one or more environmental issues or "resource concerns," the potential for environmental gain can vary across farms depending on crops, production practices, climate, location, and other factors that ultimately determine the effect of agricultural production on the environment. If existing commodity program payments and opportunities for cost-effective conservation do not occur largely on the same farms, funds devoted to conservation on farms that receive commodity program payments are likely to produce some environmental gain, but would likely produce more environmental gain per dollar spent if applied elsewhere. Green payments could support income on farms where the potential for cost-effective environmental gain is high, but these farms may or may not be the farms that have traditionally received farm income support through commodity program payments.

Finally, the treatment of producers who have already achieved a relatively high level of environmental performance is an issue. Some have argued that excluding these producers would be inequitable and could create incentives to defer conservation action. If producers who have adopted conservation

Green Payments and the WTO

Would green payments be eligible for the WTO “green box?” The “green” in “green box” is an analogy to traffic lights: Green means go. In WTO parlance, a green box program does not distort trade or causes only minimal distortions and may be implemented freely by member nations. Some have argued that green payments would be a WTO green-box-compliant way to support farm income. An analysis of conservation policy options, developed by the Secretary of Agriculture in 2006, raises important questions about green payments and the green box (USDA, 2006).

WTO rules do allow “green box” options for both income support and conservation programs. Income support payments that are “decoupled” from (not dependent on) *current* production, prices, and input use can qualify for the green box. Working-land conservation programs can also qualify for green box status if payments are for a clearly defined conservation or environmental purpose and do not exceed the extra cost or lost income directly related to conservation activities. A number of U.S. conservation programs, including the Environmental Quality Incentives Programs, have been notified (reported) to WTO under these provisions. Eligible conservation programs generally provide partial reimbursement (cost-sharing) or incentive payments designed to be equal to or less than producer costs.

Would green payments satisfy green box requirements? If green payments were to be reported as conservation payments, they could qualify if producers are compensated only for their costs or income forgone. But that would preclude income support—payments would simply offset producer costs. If green payments were to be reported as decoupled income support, on the other hand, payments could not be dependent on current input uses. Changes in input uses, however, are often the means by which conservation payments leverage environmental gains, so removing requirements for such changes may diminish their environmental effectiveness. In short, a green payment program that provided both income support and environmental gains would not necessarily qualify as a green box program under WTO rules.

practices without government payments are excluded from conservation programs (for conservation work they have already completed), they may be discouraged from going forward with conservation work in the absence of payments. In the long run, moreover, payments that exclusively subsidize change in environmental performance will eventually result in a withdrawal of support from farms that have made a great deal of environmental improvement. If policymakers want to continue supporting these producers, these already established “good actors” would have to be eligible for ongoing payments.

Existing Conservation and Income Support Programs: Different Purposes, Different Payments, Different Producers

Existing conservation and farm commodity programs have different purposes, which lead to fundamental differences in how the two types of programs are structured and administered. Commodity-based income support is intended to support farm families historically involved in the production of targeted crops by enhancing the incomes of eligible producers, primarily the producers of major field crops—corn, wheat, soybeans, cotton, and rice. Historically, producers with larger production received larger payments. Since 1996, some (but not all) commodity program payments have been based on historical crop acres and yields rather than current acres and yields. The change was designed to reduce the effect of commodity payments on production decisions and avoid stimulating overproduction. Even so, producers who farm highly productive land (with a history of high yields) that is eligible for commodity payments (by virtue of a history of program crop production) will tend to reap the largest payments. For more details, see www.ers.usda.gov/Briefing/FarmPolicy/DirectPayments.htm/.

Conservation payments, on the other hand, are designed to prompt change in land use or production practices to have a beneficial environmental effect. Conservation payments are available to a wider range of producers—nearly all crop and livestock producers are eligible for at least one conservation program. While conservation programs seek to change production practices, the level of production may or may not be affected. Land retirement is likely to affect production, although how much depends on the quality of the land retired and the extent to which other land is converted to crop production (sometimes referred to as "slippage"). But, many conservation practices have little or no impact on production levels. Producers who install terraces to reduce soil erosion, for example, are likely to see little change in production, at least in the short term. Most conservation payments are limited to the amount necessary to prompt adoption of new practices, perhaps covering only a portion of the producer's cost through cost-sharing. Some programs use competitive bidding among producers to stretch program budgets.

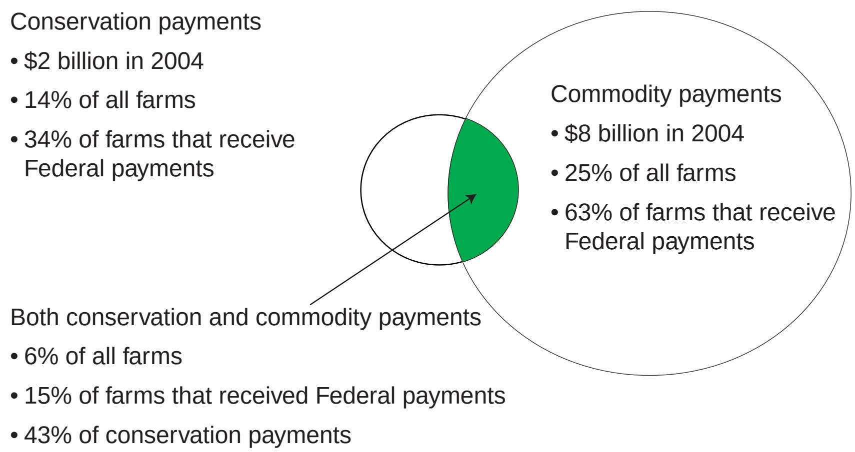
About 40 percent of U.S. farms, representing 60 percent of all agricultural production (by value), receive some type of government payment. Of that 40 percent, 15 percent—about 6 percent of all U.S. farms—received both commodity (income support) and conservation payments in 2004 (fig. 1). Since 2002, conservation program funding has increased considerably, particularly through working land programs like the NRCS Environmental Quality Incentives Program (EQIP). Because actual payments to farmers often come several years after EQIP enrollment (as specified conservation work is completed), it is likely that the number of farms receiving both commodity and conservation payments will also increase in coming years. In 2004, however, less than half of conservation payments (43 percent) went to farms that also received commodity payments, so a large share of additional conservation payments could also flow to farms that do not receive commodity payments, including many specialty crop and livestock farms.

Differences in the distribution of commodity and conservation payments across farm types and regions in the United States are striking. Most commodity program payments go to large, commercial farms, while most conservation payments go to rural residence farms[1] (fig. 2). Commodity payments are concentrated in areas where production of program crop

[1]Commercial farms are large family farms with sales above $250,000 per year and some nonfamily farms organized as cooperatives or nonfamily corporations. Intermediate farms have annual sales below $250,000 and the operator reports farming as his or her major occupation. Rural residence farms have annual sales below $250,000 where farming is considered a secondary activity both in terms of resources invested in the farm and the amount of income it contributes to the farm household.

Figure 1

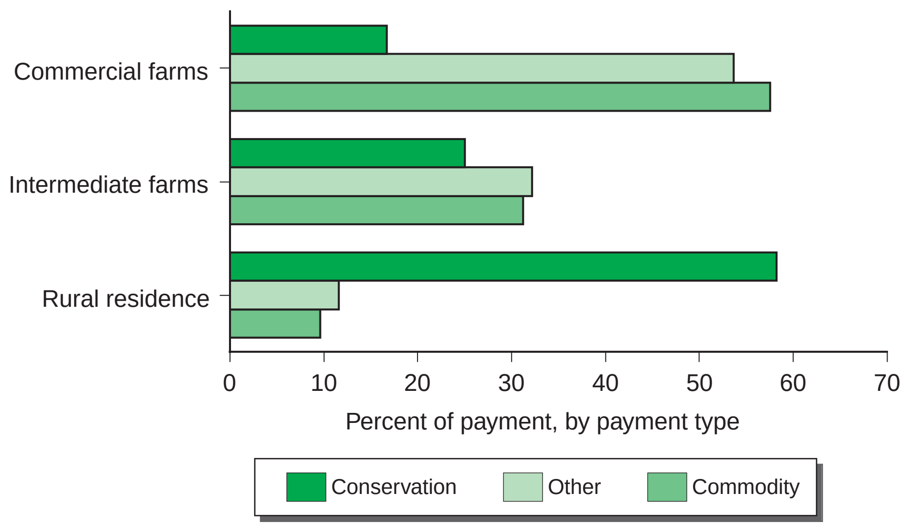
Overlap between income and conservation payment recipients is small



Source: USDA, Agricultural Resource Management Survey data, 2004.

Figure 2

Distribution of Federal agricultural payments by collapsed ERS farm typology[1]



Note: Other payments are largely ad hoc agricultural disaster payments.

[1]Collapsed ERS farm typology divides farms into three groups: (1) commercial farms are large with sales above $250,000; (2) intermediate farms have sales below $250,000 and the operator reports farming as his or her major occupation; and (3) rural residence farms have gross sales below $250,000 where farming is considered a secondary occupation or activity.

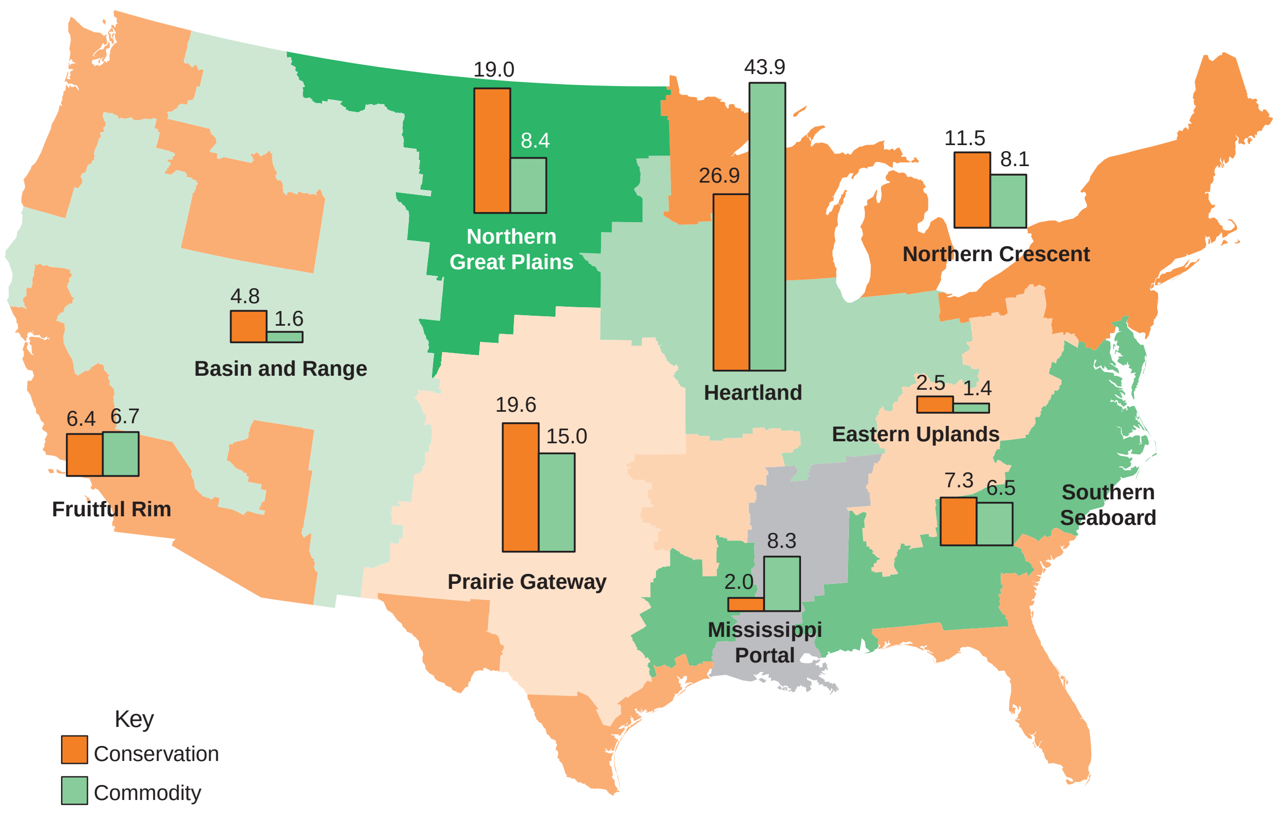
Source: USDA, Agricultural Resource Management Survey data, 2004.

commodities is prevalent—the Corn Belt, Northern Plains, and the Mississippi Delta (fig. 3). Conservation payments tend to be concentrated in some areas of the Northern Great Plains, Prairie Gateway, Northern Crescent, and Basin and Range regions (fig. 3).

To some extent, the minimal overlap between conservation and commodity payments means that environmental and income support priorities are leading these programs to focus on different producers in different regions. The existing distribution of conservation payments largely reflects a historical reliance on land retirement to attain conservation goals. Rural residence farms are more likely than other farms to retire land from crop production through government programs such as the Conservation Reserve Program (CRP), but less likely to receive farm income support payments. It is possible that these farms are more likely to be located on CRP-eligible land, although existing data are not sufficient to test this possibility. Another possible—but untested—explanation is that these farms are more willing than other farms to give up crop production (e.g., some producers may have decided to retire or seek other employment given the opportunity to enroll land in CRP). In any case, high levels of CRP participation are responsible for the fact that a large share of conservation payments flow to rural-residence farms.

Figure 3

Regional shares of commodity and conservation payments (percent of national total)[1]



[1]ERS farm resource regions are explained in *Farm Resource Regions*, AIB760. http://www.ers.usda.gov/Publications/AIB760/.

Source: USDA, Agricultural Resource Management Survey data, 2004.

In recent years, conservation program funding has risen rapidly, largely through increased funding for working land programs, primarily EQIP. As the proportion of conservation dollars spent through EQIP rises, a larger proportion of conservation dollars may also go to commercial and intermediate farms, although existing data are not sufficient to draw a strong conclusion on this point. Even if a larger proportion of EQIP funding does go to commercial and intermediate farms, however, 60 percent of funding for EQIP must, by statute, address livestock-related issues. Livestock farms are less likely than crop farms to receive payments through existing commodity programs. It is not clear how EQIP money would be distributed without the 60-percent requirement.

Green Payment Program Design: A Matter of Perspective

While analysis of existing commodity program and conservation payments suggests the potential for tradeoffs between income support and conservation objectives, some features of existing conservation programs make it difficult to reach strong conclusions based on this experience alone. For example, current conservation program funding emphasizes land retirement, while a green payments program would likely focus on encouraging conservation practices on working land. To gain additional insight, we analyze a number of hypothetical green payment program designs.

"Program design" refers to the details of a program: who is eligible, what action or activity producers could be paid for (e.g., conservation treatments), and how much they would receive for specific actions. While all green payment program designs would seek to support farm income and improve environmental performance, one could approach design decisions from a number of perspectives. To identify potential tradeoffs between income support to current recipients and environmental gain, we analyze some "polar" cases—program designs that originate from decidedly different perspectives. On the one hand, policymakers could start from a primarily environmental point of view, establishing a set of environmental payments that are large enough to leverage environmental gain and provide income support. These are *Environmental Performance* scenarios. On the other hand, policymakers could focus on the recipients of current commodity program payments, making these payments "greener" through the addition of environmental requirements, similar to (but going beyond) existing conservation compliance, sodbuster, and swampbuster requirements. (Sodbuster and swampbuster are designed to discourage producers from bringing additional highly erodible land and wetland, respectively, into crop production.) These are *Environmental Compliance* scenarios.

Some key details of program design are common to all four outlined scenarios. First, all scenarios assume that farmers are offered 5-year contracts and "program payments" are generally represented as the sum of all payments over the 5-year period. Second, because income support is a primary objective, we assume that a green payment program would be run as an entitlement, in keeping with existing farm commodity programs. Under an entitlement (like existing commodity programs), the Government is obliged to enroll producers who apply for the program and qualify for benefits. Program spending depends, in part, on the level of producer participation. In contrast, existing conservation programs are limited by an annual budget or acreage cap that limits the number of producers and acres that can be enrolled. In our green payment scenarios, the Government would establish rules governing eligibility and the calculation of payments, but the exact level of program payments for any specific scenario is determined by the number of farms that participate, the number of acres they choose to enroll, and the conservation treatments they apply.

In the *Environmental Performance* scenarios, farmers and ranchers are offered the opportunity to (voluntarily) produce environmental "goods" for a "price" established by the Government. Environmental goods could include clean water or wildlife habitat that farmers and ranchers produce by applying conservation treatments. For example, they could help produce clean water by controlling runoff of sediment, nutrients, and/or pesticides from agricultural land. See table 1 for a full listing of the resource concerns that could be addressed in our green payment scenarios and the conservation treatments that might be used to address them.

In keeping with existing conservation programs, producers are allowed to determine (within guidelines) which land and conservation treatments they will offer for green payment program participation. All cropland and grazing land could be eligible for program enrollment, so long as the proposed conservation treatment would address a specific resource concern present on or associated with the tract being offered. The payment a producer could receive for taking these actions would be roughly proportional to his or her probable contribution to the production of environmental goods. Our analysis uses an environmental index, similar to the Environmental Benefits Index (EBI) used in the CRP, to quantify a producer's environmental performance and estimate the gain in environmental performance from any given conservation treatment (see box, "The Environmental Index," and appendix 1 for full details). Specific scenarios include:

- ***Improved Performance.*** Payments would be based on expected environmental gain, as measured by our environmental index. Producers would receive payments based on the application of *additional* conservation treatments that yield a *gain* in environmental performance. The payment made to a producer would equal the change in the producer's environmental index score (no matter what his or her starting point), multiplied by a payment rate per index point determined by the Government and announced to producers as part of the program signup notice.

Table 1
Linking resource concerns, land use, physical effects, and treatments

Resource concern	Physical effect	Land use	Treatment
Air quality	Wind erosion	Cropland[1]	Wind erosion control
Surface-water quality	Water erosion	Cropland	Water erosion control
	Nitrogen runoff	Cropland	Nutrient management
	Phosphorus runoff	Cropland	Nutrient management
	Nutrient runoff and riparian erosion	Grazing land	Nutrient management and riparian erosion control
	Pesticide runoff	Cropland	Pest management
Groundwater quality	Nitrogen leaching	Cropland	Nutrient management
	Pesticide leaching	Cropland	Pest management
Soil productivity	Wind erosion	Cropland	Wind erosion control
	Water erosion	Cropland	Water erosion control
Grazing land health	Grazing land health	Grazing land	Grazing land health
Wildlife	Wildlife habitat loss or degradation	Cropland	Habitat restoration or enhancement
		Grazing land	Habitat restoration or enhancement

[1]Irrigated and nonirrigated cropland are combined here but are treated separately in our analysis.

Source: USDA, Economic Research Service.

The Environmental Index

To base payments on environmental performance, some method of measuring performance is needed. Environmental indexes are used widely in conservation programs to gauge the potential environmental gain from the application of conservation treatments. Indexes combine data on a number of environmental dimensions into a single number. In several USDA programs, including the Conservation Reserve Program (CRP) and the Environmental Quality Incentives Program (EQIP), program managers use indexes to rank contracts for program enrollment. For a limited number of resource concerns, the Conservation Security Program also offers payments that vary according to improvement in the value of indexes believed to reflect environmental performance. In our model of green payments, we develop an overall index of environmental performance and use it to specify environmental performance-based payments.

Our index is similar to the Environmental Benefits Index (EBI) used to rank contract offers in the CRP general signup:

- Roughly one-third of points are for soil erosion on cropland. Points are given for potential of erosion control to reduce dust (improve air quality), preserve soil productivity, and reduce sediment loads to water.
- Another third are for other water quality-related treatments, including nutrient management and pest management on cropland, nutrient management and riparian erosion on grazing land, and grazing land health.
- Remaining points are for wildlife habitat enhancement (on cropland and grazing land).

The share of possible points assigned to a specific farm depends on the intensity of the physical effects (e.g., soil erosion or nutrient runoff) and the potential damage to soil, water quality, or other resources. For example, if soil erosion due to water (tons per acre per year) is estimated to be high on a field located in an area where water-quality damage per ton of soil erosion is also estimated to be high, a large share of potential points would be assigned for the index subcomponent that accounts for sediment damage to water quality. A complete description of the index can be found in appendix 1.

- ***Good Performance.*** Payments would be based on environmental *performance*. Once producers reach a predetermined level of environmental performance—which we refer to as an environmental hurdle—they are eligible for payments. Producers do not necessarily need to apply new conservation treatments—they can qualify for payments even if environmental performance was achieved before the establishment of the green payment program. The hurdle rate is set by region so that about half of all agricultural land in each region qualifies for payments without additional conservation effort.[2] Producers who have already surpassed the hurdle can also increase payments by further improving environmental performance (undertaking additional conservation treatments). For an individual producer, payment would be equal to the difference between his or her index score and the environmental hurdle, multiplied by the payment

[2]The hurdle rate could have been calculated at other geographic scales. For a comparison of basic results using regional and national hurdle rates, see Appendix 5: Sensitivity Analysis.

rate per index point. That is, the payment equals the payment rate times the difference between the index score and the hurdle rate, if the index score is greater than the hurdle rate. If the index score is less than the hurdle rate, the payment is zero.

In the *Environmental Compliance* scenarios, existing farm commodity payments are used to leverage additional conservation effort and improve environmental performance. Existing compliance requirements for wetland conservation and soil conservation on highly erodible cropland (HEL), in force since 1985, would remain unchanged, while new compliance requirements would be added. New compliance requirements would include reducing soil erosion to the soil loss tolerance ("T" level) on non-HEL cropland, as well as nutrient management and pest management on cropland.[3] Specific scenarios include:

- ***Extended Compliance.*** Continued eligibility for commodity program payments would be contingent on addressing all existing and new compliance requirements, regardless of cost. Producers who do not meet all applicable requirements would become ineligible for commodity program payments, and the income support they provide, on all the land they farm.

- ***Modified Compliance.*** Producers could opt out of some of the new requirements if they accept a reduced payment. Producers who address no additional requirements would still receive 20 percent of the maximum payments they would be eligible for. Producers who address all additional requirements would receive 100 percent of their potential payment. For producers who opt out of some, but not all additional requirements, payment reduction would be commensurate with the environmental gain forgone, as measured by our environmental index.

[3]Note that grazing land cannot be enrolled and that wildlife habitat resource concerns cannot be addressed through compliance scenarios.

Table 2
Summary of scenarios for green payment analysis

Scenario type	Scenario	Eligible farms/land	Payment "trigger" (action/condition)	Payments
Environmental Performance	1. Improved Performance	All cropland and grazing land; farms that include either cropland or grazing land	Any additional treatment appropriate to the farm	Based on environmental gain, as measured by the *change* in environmental index score
	2. Good Performance		Environmental performance exceeds a predetermined "hurdle" rate	Based on environmental performance, as measured by environmental index, relative to the hurdle rate
Environmental Compliance	3. Extended Compliance	Cropland on farms that receive income support	Meet existing compliance requirements and control soil erosion on all land, manage nutrients; pests	Similar to existing direct payments; producers must meet all conservation treatment requirements to maintain eligibility
	4. Modified Compliance		Meet existing compliance requirements and control soil erosion on all land, manage nutrients; pests	Producers can opt out of some conservation treatment requirements for a reduction in payments, commensurate with reduction in environmental performance, as measured by environmental index

Source: USDA, Economic Research Service.

Producer Participation: Doing the Math

Farm income and environmental outcomes depend largely on whether (and how) farmers and ranchers choose to participate in a green payment program. Imagine a producer sitting down to "pencil out" his or her green payment program options. He or she may have a number of tracts of land that could qualify for payments if one or more resource concerns were addressed. Addressing a resource concern would entail the application of an appropriate conservation practice or a set of practices (sometimes referred to as a conservation "treatment"; see table 1). The existence of a water-quality concern, for example, may lead to treatment for soil erosion (to reduce sediment flows), nutrient runoff, or pesticide runoff through conservation tillage (and other soil erosion control practices), nutrient management, or pest management, respectively.

The producer's participation decision boils down to a single question: Am I willing to accept the payment offered in exchange for undertaking the prescribed conservation treatment(s)? Producers may consider a range of factors in deciding whether a given payment is large enough:

- out-of-pocket costs
- changes in production (e.g., change in crop yields)
- difficulty of managing and maintaining required conservation practices
- changes in production risk (e.g., an increase or decrease in the probability of low yields).

All of these factors come together in the producer's willingness to accept (WTA), defined as the minimum payment he or she would be willing to accept in exchange for taking a specified action. Farmers and ranchers will participate any time the prospective payment exceeds their WTA for the conservation treatment in question. If a producer is willing to accept $4 per cropland acre for nutrient management, for example, he would agree to undertake nutrient management if the per-acre payment for nutrient management is $4 or higher. For ease of exposition, we also refer to WTA as "economic cost" because all factors outlined above are real (or economic) costs to the producer, even if they are not out-of-pocket costs. From a Government perspective, we also refer to economic costs as net conservation expenditures because it is the minimum the Government must pay to leverage a specific conservation action on a specific farm. Payments in excess of economic cost (WTA) are income support.

We simulate the process of "penciling out" green payment options for each one of a series of model farms, based on the 2002 Agricultural Resources Management Survey (ARMS):

- For each green payment program scenario defined above, we simulate a set of green payment participation options for each farm.[4] The options are based on the requirements of the scenario, e.g., the types of land and conservation treatments that trigger payment, and a farm-specific estimate of the number of acres that could be treated (see appendix 2 for details).

[4]Producers have multiple options in each of the scenarios except *Extended Compliance*.

- The level of payment the producer would be willing to accept for undertaking any specific option is estimated using contract data from the Environmental Quality Incentives Program and techniques detailed in appendix 3.
- In general, we assume that the producer selects the option that yields the largest net return over economic costs or net income support. In other words, we define net return and net income support as the total payment to the producer less the producer's economic cost for undertaking prescribed conservation treatments (see appendix 4 for a detailed discussion of producer decision rules). We also assume that producers will participate only when net return exceeds $200 (total) to offset transaction costs, e.g., the cost of application and related expenses.

Because the scenarios are analyzed as entitlements, total payments to producers are a function of producer response to the payment rates offered, rather than a program budget. To compare our scenarios across a wide range of program sizes (i.e., total producer payments), we vary these payment rates. For the *Improved Performance* and *Good Performance* scenarios, program payments are varied implicitly by varying the payment rate per environmental point. As the payment rate rises, more producers participate, and those who would have participated at a lower payment rate undertake additional conservation treatments. Because the scenarios are different, however, the payment rate corresponding to a given level of program payments varies across scenarios.

For the *Extended Compliance* and *Modified Compliance* scenarios, program payments are also varied implicitly by varying the farm-specific level of direct payments (as reported for the ARMS farms that are the basis for the analysis) using a scale factor. For example, if the scale factor is 1.2, each farm would receive (at most) 120 percent of the direct payment the farm received in 2002. Given the economic cost of complying with environmental compliance requirements, participation in the environmental compliance scenarios increases as the scale factor increases. For *Modified Compliance*, moreover, producers also undertake additional conservation treatments—treatments they may otherwise have opted out of—as the scale factor rises.

Green Payment Program Design Tradeoffs: Do Income Support and Environmental Gain Go Well Together?

While there are many ways to combine conservation and commodity payments, the real question is whether they are a good match. The answer depends largely on policymakers' conservation and income support objectives. Using the distribution of payments under existing commodity programs as a benchmark, however, we can analyze some key questions that policymakers would almost surely face in designing a green payment program:

- What proportion of green payments ends up as income support?
- How much environmental gain is obtained given the level of net conservation expenditure?
- How does conservation cost-effectiveness affect the *distribution* of income support?

What proportion of green payments ends up as income support? At some level, there is always a tradeoff between income support and the environment. In a green payment context, policymakers implicitly relinquish control over the allocation of funds between income support and environmental gain in order to merge these two program objectives. The portion of producer payments that offsets producer economic costs cannot support farm income. Once the economic cost of required conservation actions are covered, the remainder of the green payment is net farm income support.

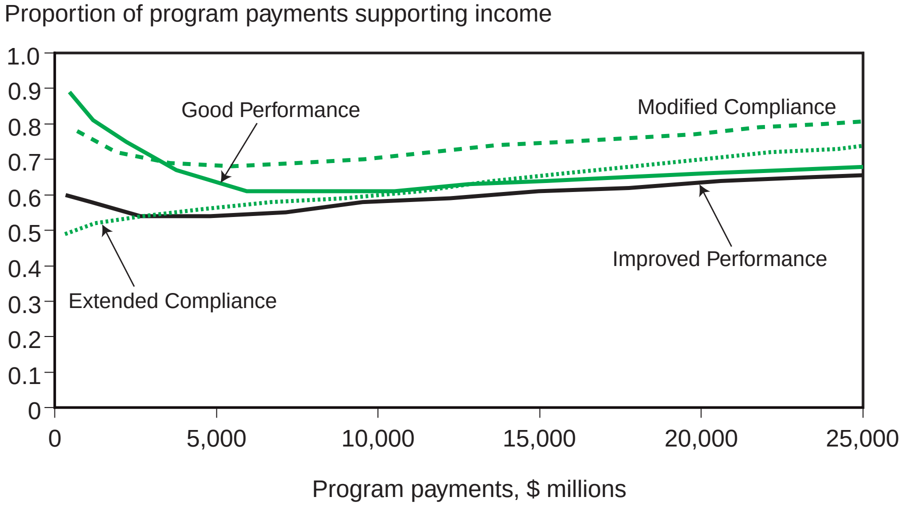
Both *environmental compliance* and *environmental performance* scenarios deliver environmental gain and income support. The portion of total producer payments that covers the economic costs of taking specified conservation actions varies from 10 percent to as high as 50 percent, depending on the program scenario and the overall level of program payments. The balance of the payments—net income support —ranges from 50 to 90 percent of overall program payments (fig. 4). The ultimate effect of this split between conservation and income support expenditures on overall income support and conservation effort also depends on whether a green payments program is in addition to or instead of existing programs.

At an aggregate level, the tradeoff between net income support and net conservation expenditure is modest. When program payments are relatively low (less than $5 billion over 5 years), the *Good Performance* and *Modified Compliance* scenarios yield the highest overall levels of income support. That's because producers can participate without additional environmental effort. Low payments result from low payment rates, prompting many producers to base their participation on existing conservation efforts rather than new conservation action, if possible. So, payments are largely devoted to income support. In contrast, income support is relatively low for the *Improved Performance* and *Extended Compliance* scenarios, where producers must take additional action to receive payments.

When payments are larger—$20 billion or more over 5 years—the compliance scenarios yield the largest income support, although the difference

Figure 4

Net income support as a proportion of program payments



Source: USDA, Economic Research Service.

between the environmental compliance and environmental performance scenarios is not dramatic. The proportion of payments going for income support in the environmental compliance scenarios rises quickly as payments become large, reflecting the fact that limiting eligibility (to recipients of existing commodity program payments) also limits opportunities for conservation treatment. In other words, as the scale factor in the environmental compliance payments rises, there is a shrinking pool of eligible acres that still need conservation treatment.

How much environmental gain is obtained given the level of net conservation expenditure? That is, how cost-effective is each scenario in terms of environmental gain per dollar of conservation spending? A specific green payment program design is cost-effective *relative to* another design if it produces more environmental gain for a given level of net conservation expenditure (*not* total program payments, which also include an income support component). Because the overall level of income support lies in a relatively narrow range across green payment scenarios, particularly when total payments are $5 billion or larger, net conservation expenditures also lie within a relatively narrow range. Given similar levels of net conservation expenditure, differences in environmental gain depend largely on the cost effectiveness of conservation expenditures.

Environmental gain depends critically on program design. Figure 5 shows net income support and environmental gain (in terms of environmental points) for our four hypothetical green payment programs at three different levels of overall program payments. The oval in the lower left-hand side of the plot area shows net income support and environmental gain for each scenario when program payments are $5 billion (total over 5 years). Other ovals correspond to total payments of $10 billion and $15 billion.

As a point of comparison, we also graph a fifth scenario in which all funds are channeled into environmental gain. We refer to this scenario as *Environmentally Efficient*. The points representing various levels of program payments are located on the vertical (environmental points) axis in figure 5. This scenario is identical to *Improved Performance* except that payments are only large enough to cover producer economic costs (WTA). In other words, the entire payment goes to leverage conservation; income support is zero. In theory, competitive bidding can yield payments just large enough to cover producer conservation cost, although it would be very difficult to design and implement an auction in which all producers submitted bids equal to their economic costs. Nonetheless, this scenario gives an upper bound for the potential of a purely environmental program.

The downward sloping curves in figure 5 represent all combinations of income support and environmental gain that could be achieved by separate programs focusing, respectively, on income support and conservation, given $5 billion, $10 billion, and $15 billion in total payments (the sum of conservation expenditure and net income support). We refer to these curves as cost-effectiveness frontiers. Suppose fixed budgets of $5 billion, $10 billion, and $15 billion are available for allocation between the *Environmentally Efficient* scenario and an income support program similar to the existing direct payment program. By varying the allocation of funds across the two programs and using our model to estimate the maximum possible environmental gain, we define all feasible combinations of income support and environmental gain, given the available budget. Combinations of environmental gain and income support that are on or inside (below and the left of) the cost-effectiveness frontiers can be achieved given $5 billion, $10 billion, and $15 billion in program payments.

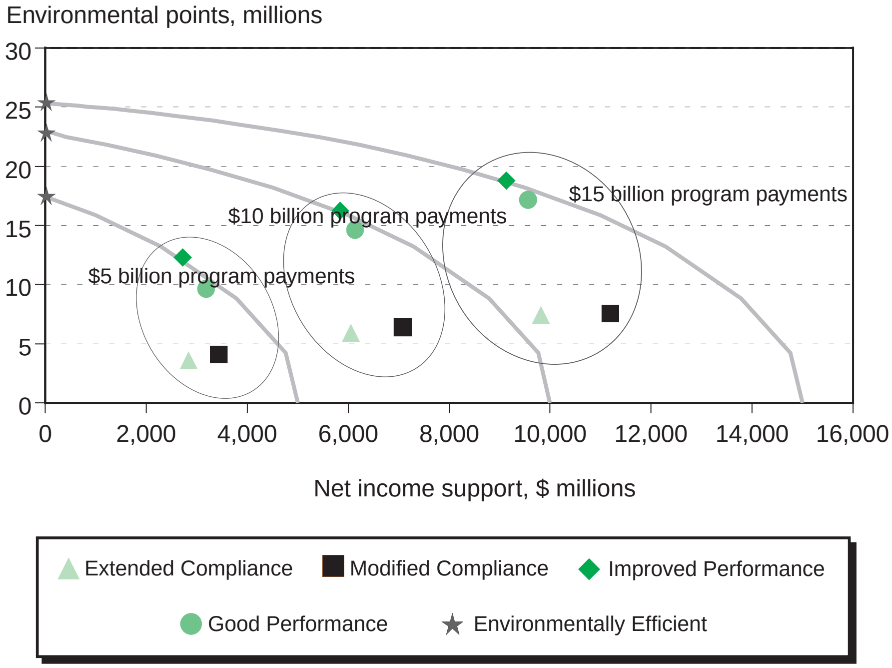
These cost-effectiveness frontiers show the underlying tradeoff between environmental gain and income support when separate, cost-effective programs are used to leverage environmental gain and provide income support. Following the $10-billion frontier beginning at the horizontal axis in figure 5, shifting funds from income support to the *Environmentally Efficien*t scenario would increase environmental gain, rapidly at first (the frontier is almost vertical) indicating that some environmental gain can be achieved at very low cost. As more money is shifted from income support to environmental gain (moving toward the upper left) additional environmental gain declines as indicated by the decrease in the slope of the cost-effectiveness frontier. The increase in the cost of additional environmental gain is driven by the fact that payment incentives encourage producers to undertake the least expensive (most cost-effective) gains first.

Figure 6 is similar to figure 5, but shows treated acreage rather environmental points. Figure 6 shows that treated acreage is not necessarily a good indicator of environmental gain. While some scenarios (other than *Improved Performance*) can treat as many or even more acres than could be treated with the *Environmentally Efficient* scenario, different acres would be treated—acres that would produce less environmental gain as measured by our environmental index. Environmental targeting generally produces this type of result—policymakers choose to pass up acres that could be treated cheaply in favor of treating acres that produce large environmental gain relative to treatment cost.

Returning to figure 5, note that only the *Improved Performanc*e and *Environmentally Efficient* scenarios are on the cost-effectiveness frontiers.

Figure 5

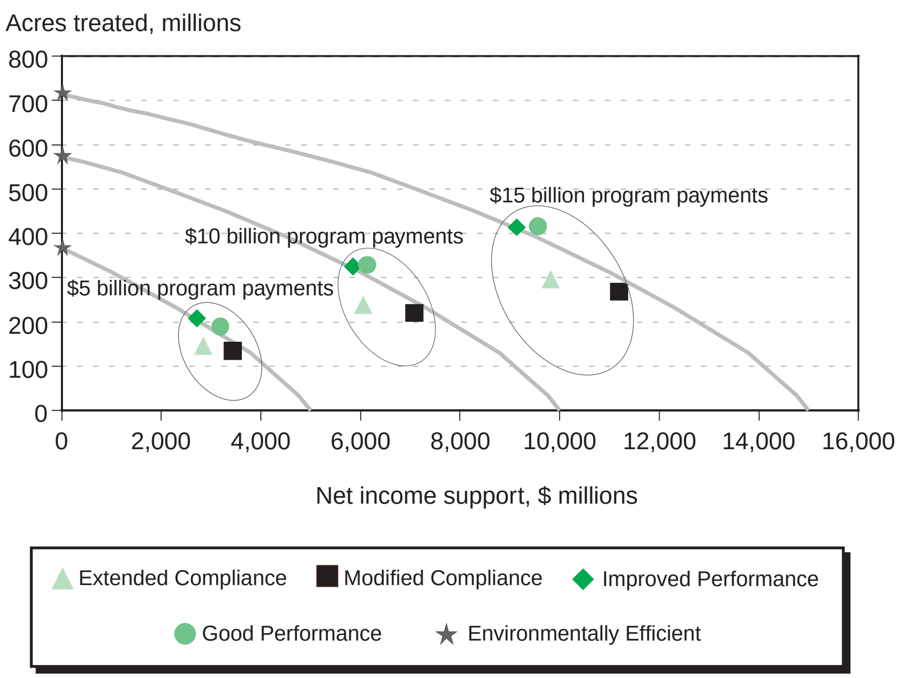
Efficiency matters: Trading environmental gain and income support in green payment program design



Source: USDA, Economic Research Service.

Figure 6

Efficiency matters: Trading treated acreage and income support in green payment program design



Source: USDA, Economic Research Service.

Consider the *Improved Performance* scenario on the $10-billion frontier (the middle of the three curves). Of the $10 billion in producer payments, roughly $4 billion offsets conservation costs, yielding about 16 million environmental points and leaving $6 billion for income support. Because this scenario is already on the cost-effectiveness frontier, it would be impossible to increase environmental gain without reducing overall income support, and vice versa, while staying within the overall $10-billion budget. The same is true for the *Environmentally Efficient* scenario: if some of the $10 billion in payments were allocated to income support, overall environmental gain would decline.

Our other green payment scenarios are not on the cost-effectiveness frontier, indicating that more environmental gain, more income support, or both could be obtained without increasing overall program payments. The *Good Performance* scenario, in which "good actors" are eligible for payments even if they do not improve their environmental performance, is close to the cost-effectiveness frontier, delivering slightly less environmental gain and slightly more income support than the *Improved Performance* scenario. In this scenario, the decision to support producers who have achieved a relatively high level of environmental performance—even if they take no action to improve their performance—is achieved at the cost of a modest loss in environmental gain.

In contrast, the environmental compliance scenarios produce substantially less environmental gain than either environmental performance scenario. The *Extended Compliance* scenario, moreover, delivers very little additional overall income support. The *Modified Compliance* scenario does a bit better—it would yield the same or slightly more environmental gain than *Extended Compliance* while also producing a higher level of overall income support. In these scenarios, the decision to direct support toward the current recipients of farm commodity program payments comes at the cost of a substantial loss in environmental gain.

Differences in cost-effectiveness across our four scenarios are largely a function of three key determinants: 1) the broadness of eligibility requirements; 2) the effectiveness of payment incentives in encouraging the participation of producers who can deliver environmental benefits at low cost; and 3) the flexibility that producers have in responding to those incentives. In the environmental performance scenarios, broad eligibility ensures that producers who can deliver cost-effective environmental gains can participate. Payments reflect the potential for environmental gain, encouraging the participation of producers who can offer environmental gains that are large relative to the cost of obtaining these gains. Finally, because producers are free to decide which tracts of land they will offer for enrollment and which practices they will adopt on those tracts, they are free to offer only the land and practices for which the payment (which is proportional to environmental gain) exceeds economic costs.

By contrast, *Extended Compliance* offers only limited eligibility, payments that are unrelated to environmental gain, and no flexibility on environmental requirements. Producers must meet all environmental requirements or face loss of eligibility for payments. If producer economic cost varies widely across conservation treatments, individual producers may be able to make a cost-effective contribution toward some environmental objectives but not others. Some farms would elect to undertake these treatments because their overall payment would be larger than their overall economic cost of conservation improvements. Other farms would decide not to participate at all, given the level of payment they could receive and the cost they would incur. As a result, the overall economic cost of environmental gain is high.

Modified Compliance is more environmentally cost-effective than *Extended Compliance* because the opt-out provision offers producers both flexibility and the incentive to exercise that flexibility in a way that increases cost-effectiveness. Unlike *Extended Compliance, Modified Compliance* allows producers to opt out of some requirements, if they agree to a reduction in payment commensurate with the loss of environmental gain due to the opt-out. If the payment reduction is commensurate with the level of benefits forgone, producers will opt out only when the benefits of a given conservation treatment fail to outweigh the cost of the treatment. In other words, producers will opt out of treatments only when they are not cost-effective. Net income support to participating producers also increases (relative to the extended compliance scenario) because the reduction in payment is less than the reduction in economic cost. By allowing producers to focus on relatively cost-effective environmental gains, both environmental gain and income support can be increased in relation to *Extended Compliance*.

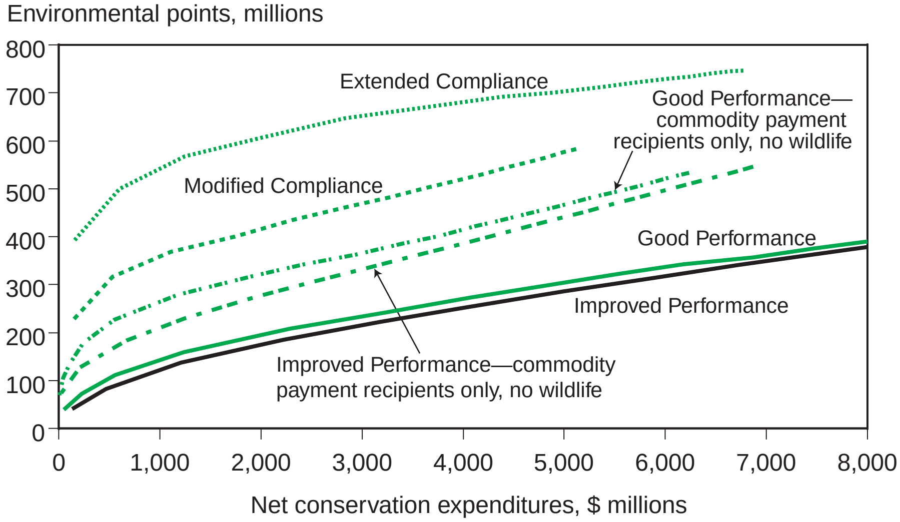
To what extent is higher cost effectiveness in the environmental performance scenarios driven by differences in eligibility versus differences in incentives? That is, are the environmental performance scenarios more cost effective simply because they can include a broader range of producers and land? To separate these effects, the environmental performance scenarios were re-estimated, restricting eligibility to recipients of existing income support and excluding payments for wildlife habitat-related treatments, because this is not required in the compliance scenarios. Figure 7 shows the cost-effectiveness curves for all four green payments scenarios but also shows curves for the *Improved Performance* and *Good Performance* scenarios under the assumption that eligibility is limited to the same producers and resource concerns that are eligible for payments in the environmental compliance scenarios. Although the change in assumptions does increase the average cost of environmental gain in the environmental performance scenarios, costs are still substantially lower than in either environmental compliance scenario. These results show that both broad eligibility and effective incentives are needed to obtain cost-effective environmental gain.

How does conservation cost-effectiveness affect the distribution of income support? Policymakers may face a difficult tradeoff between environmental gain and the *distribution* of income support. The same program design features that lead to cost-effective environmental gain also result in a distribution of net income support, across producers, that is quite different from that of existing commodity programs.

A key factor is broad eligibility. While cost-effectiveness is enhanced by ensuring that all producers who can make a cost-effective contribution are included, net income support is also spread much more broadly across the farm sector. Figure 8 shows the number of participating farms for all four scenarios against total program payments. For program payments of $3 billion or more (total over 5 years), the number of farms participating in

Figure 7

Net conservation expenditure per environmental point



Note: Conservation expenditures don't reach $8 billion in some scenarios because overall payments are limited to $25 billion. The compliance-based scenarios yield larger farm income support than do performance-based scenarios, particularly when overall program payments are larger (see fig. 4).

Source: USDA, Economic Research Service.

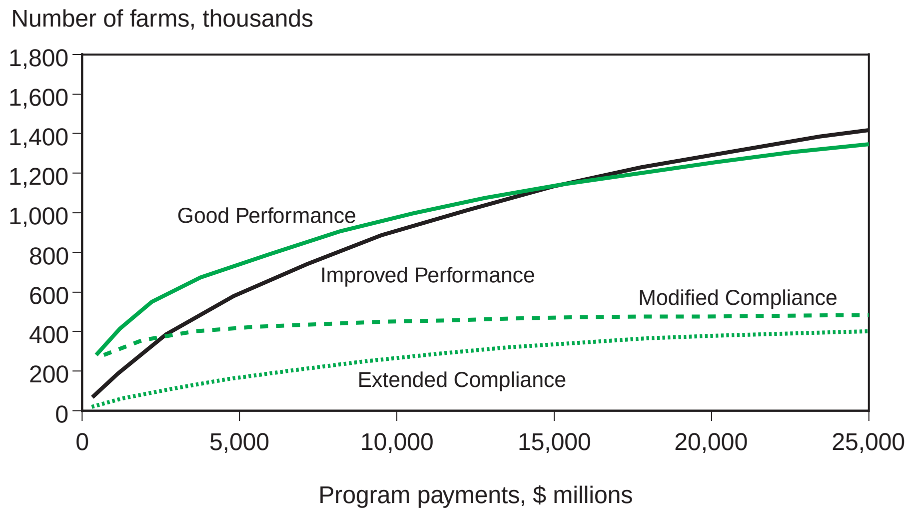
either environmental performance scenario exceeds participation in either environmental compliance scenario. Because participation in environmental performance scenarios is relatively large, payments per farm are small when compared to per-farm payments received through the environmental compliance scenarios.

Environmental performance and environmental compliance scenarios also vary in distribution across the ERS combined farm typology, commodity specialization, and ERS farm resource regions. Figure 9 shows the distribution of net income support across the ERS combined farm typology for the green payment scenario. Commercial farms (with gross annual sales of more than $250,000) capture the largest share of net income support in every scenario, although their share is somewhat larger for the compliance scenarios, particularly *Modified Compliance*. Compared to payments that are distributed like existing direct payments, however, income support is lower because of conservation treatment costs.

While commercial farms receive the largest share of income support, the environmental performance scenarios tend to shift support toward intermediate and rural residence farms. Intermediate farms (gross sales of less than $250,000) capture the next largest share of income support. For the performance-based scenarios, intermediate farms receive almost as much overall income support as commercial farms, although they would receive less on a per-farm basis because there are more intermediate farms than commercial farms. Rural residence farms, which tend to be small and are typically operated by retirees or individuals with full-time off-farm jobs, receive the smallest share of total income support. Nonetheless, these producers receive as much net income support in the performance-based scenarios as they would from payments that mimic the existing direct payments program.

Figure 8

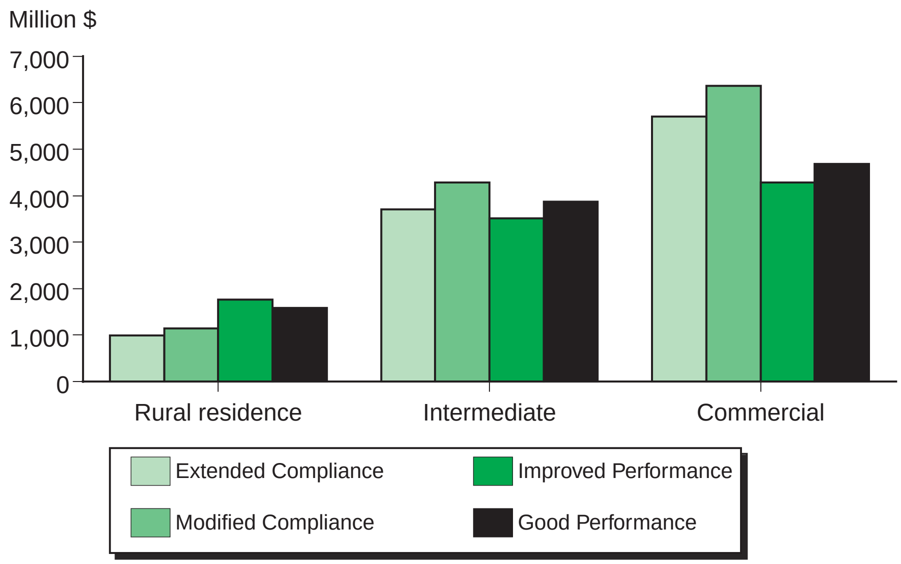
Number of participating farms by green payment scenario



Source: USDA, Economic Research Service.

Figure 9

Net income support by scenario and combined typology

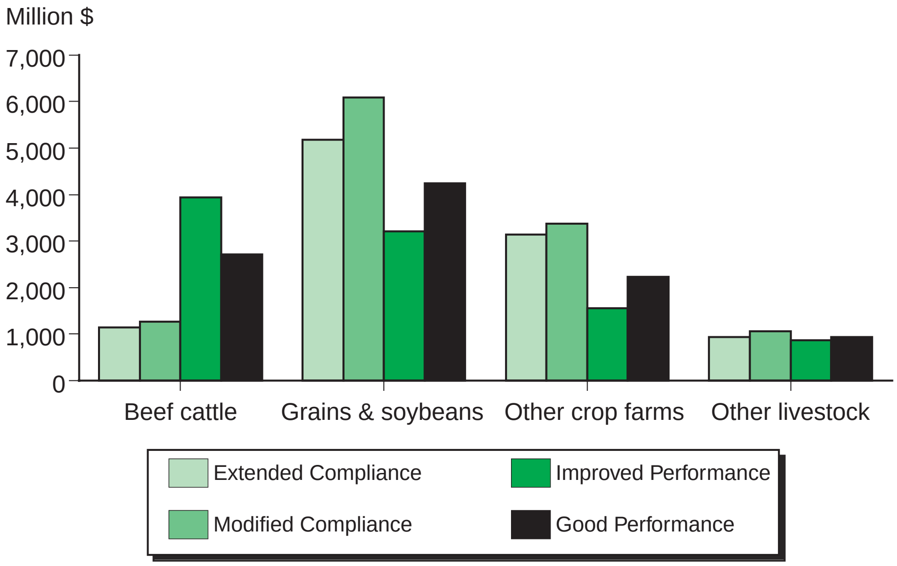


Source: USDA, Economic Research Service.

In terms of commodity specialization, beef producers do quite well in the environmental performance scenarios, despite the cost of conservation treatment (fig. 10). Beef producers hold large acreages of grazing land, which is eligible for payments under *Improved Performance* and *Good Performance* but not for existing direct payments or under *Extended Compliance* and *Modified Compliance*. For crop producers, who tend to receive larger payments under existing income support programs, the situation is reversed: Net income support is larger for scenarios based on existing income support programs.

Figure 10

Net income support by scenario and primary commodity



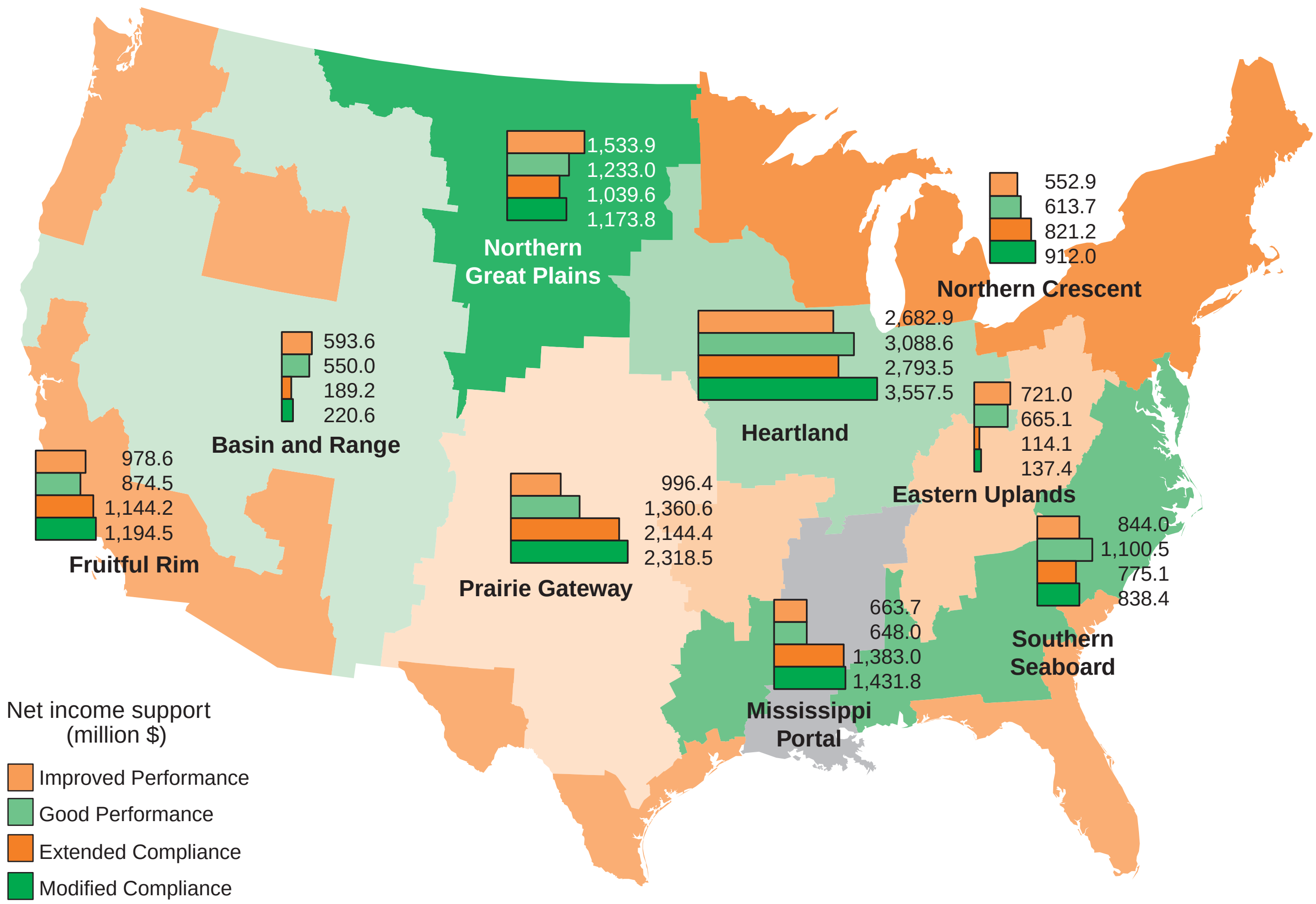
Source: USDA, Economic Research Service.

Regionally, income support tends to be large in the Heartland in all four scenarios, and particularly the two income support scenarios, because a large share of agricultural land, particularly cropland, is located there (fig. 11). Payments in the *Improved Performance* and *Good Performance* scenarios tend to be more uniform across regions than for the compliance scenarios. Under *Improved Performance* and *Good Performance,* for example, regions like the Eastern Uplands and Basin and Range receive a substantial level of income support, even though they currently receive a relatively small share of direct payments. In the compliance scenarios, the Heartland and Prairie Gateway regions are favored because they receive a large share of existing direct payments.

Can the tradeoff between environmental cost-effectiveness and the distribution of income support be avoided? Our analysis indicates that only separate income support and conservation programs offer policy-makers full flexibility to tailor income support and conservation payments to maximize environmental gain and achieve a distribution of income support payments that matches that of the existing direct payment program (or any other distribution policymakers choose to implement). Because the environmentally efficient and pure income support scenarios are separate, the desired distribution of income support does constrain cost-effectiveness and vice versa. The mix of overall income support and environmental gain achieved with *Improved Performance* can also be achieved, at least in theory, with *Environmentally Efficient* payments and pure income support without any constraint on the distribution of income support. Even though this exact outcome would be difficult to achieve in reality, the additional constraint imposed by combining income and environmental payments would likely make it impossible.

Figure 11

Net income support by scenario and ERS Resource Region, program payments $16 billion



Source: USDA, Economic Research Service.

Conclusions

A green payment program that integrates commodity and conservation program objectives would provide both income support and environmental gain over a wide range of program designs. Our estimates indicate that 50 percent or more of payments could support farm income and that conservation treatment could be applied to several hundred million acres, given program budgets of $5 billion to $15 billion (total over 5 years). Nonetheless, the overall level of environmental gain and the distribution of income support can differ widely across green payment program designs.

If policymakers want the distribution of income support in a green payment program to approximate that of existing commodity program payments, they will need to accept less environmental gain than could be realized from a program designed from an environmental point of view. Opportunities for cost-effective conservation treatments do not always occur on farms that receive existing commodity program payments. A dollar spent on conservation in the environmental compliance scenarios would yield less environmental gain than it would if spent on conservation through one of the environmental performance scenarios. In general, green payments will be more environmentally cost effective when eligibility is broad, incentives encourage producers to take actions that yield high environmental benefit at low cost, and program participation requirements are flexible enough to allow producers to pursue these actions. Focusing on existing commodity program participants will exclude many producers who could deliver cost-effective environmental gain.

Of course, a program developed from a purely environmental point of view will also yield a dramatically different distribution of income support from that of existing direct payments. Although total income support is estimated to be similar in magnitude across all of the green payment scenarios we considered, those focused on environmental performance would spread income support more evenly across farms and regions. Crop farms would tend to realize less income support when compared to a program similar to the existing direct payment program while livestock farms (especially beef farms) would likely realize similar or larger support. Regions where small farms and livestock farms dominate (the Eastern Uplands and Basin and Range) would see a significant increase in support largely at the expense of regions that dominate existing farm commodity programs. Moreover, because participation is estimated to be greater in designs that focus on environmental performance, more producers benefit but income support per farm is much smaller than it would be for designs where eligibility for existing commodity programs is a starting point.

According to economic theory, accomplishing two goals in a cost-effective way will generally require two programs or policy instruments. That means that a single program of green payments will be less cost effective in achieving program goals than would separate programs for environmental gain and producer income support. As already shown, the combination of a program targeting environmental gain (similar to the *Environmentally Efficient* scenario) and another targeting income support (similar to the existing direct payments) can achieve a cost-effective outcome without restricting the distribution of income support. An environmental program similar, perhaps, to EQIP with competitive bidding, could be used to obtain environmental gain.

If policymakers decide to go forward without considering the existing distribution of commodity program payments, a green payments program could provide an alternative rationale for income support. Performance-based payments (analyzed in the *Improved Performance* and *Good Performance* scenarios) would allow producers to produce environmental "goods" for a price established by the Government. This approach would be somewhat similar to that of the Conservation Security Program (CSP), where some payments are currently based on reaching a threshold of environmental performance and other payments are based on environmental gain, measured by an environmental index. If policymakers view green payments as a long-term approach to income support and environmental gain, a mix of payments for new environmental gain and ongoing environmental stewardship may encourage producers to improve and, ultimately, maintain high environmental performance.

References

Alexander, R.B., R.A. Smith, and G.E. Schwartz. 2000. “Effect of stream channel size on the delivery of nitrogen to the Gulf of Mexico,” *Nature*, 403: 758-761.

Atwood, J. D. Buland, A. Cattaneo, A. Esser, L. Knight, L. Toomer, D. Vik, and J. Whitcomb. 2003. *Environmental Quality Incentives Enhancement Program: Benefit-Cost Assessment.* U.S. Department of Agriculture, Natural Resources Conservation Service, May.

Atwood, J., R. Claassen, J. Featherstone, L. Knight, L. Moore, and G. O’Neill. 2004. *Conservation Security Program: Benefit-Cost Assessment.* U.S. Department of Agriculture, Natural Resources Conservation Service, May.

Claassen, R., L. Hansen, M. Peters, V. Breneman, M. Weinberg, A. Cattaneo, P. Feather, D. Gadsby, D. Hellerstein, J. Hopkins, P. Johnson, M. Morehart, and M. Smith. 2001. *Agri-Environmental Policy at the Crossroads.* U.S. Department of Agriculture, Economic Research Service, AER-794

Claassen, R., V. Breneman, S. Bucholtz, A. Cattaneo, R. Johansson, M. Morehart. *Environmental Compliance in Agricultural Policy: Past Performance and Future Potential.* 2004. U.S. Department of Agriculture, Economic Research Service, AER-832.

Feather, P., and D. Hellerstein. 1997. “Calibrating Benefit Function Transfer to Assess the Conservation Reserve Program,” *American Journal of Agricultural Economics* 79(1): 151-162.

Feather, P., D. Hellerstein, and L. Hansen. 1999. *Economic Valuation of Environmental Benefits and the Targeting of Conservation Programs: The Case of the CRP.* U.S. Department of Agriculture, Economic Research Service, AER-778.

Gloss, Don W., Robert L. Kellogg, Joaquin Sanabria, Susan Wallace, and Walt Kniesel. 1998. *The National Pesticide Loss Database: A Tool for Management of Large Watersheds.* Poster Presentation at the 53rd Annual SWCS Conference San Diego, California, July 5-9, 1998. Data available at http://www.nrcs.usda.gov/technical/land/pubs/gosstext.html.

Hansen, L., V. Breneman, C. Davison, and C. Dicken. 2002. “The Cost of Soil Erosion to Downstream Navigation.” *Journal of Soil and Water Conservation* 57(4): 205-212.

Piper, Steven, and Paul C. Huszar. 1989. “Re-examination of the offsite costs of wind erosion in New Mexico.” *Journal of Soil and Water Conservation.* July-August, pp. 332-334.

Ribaudo, M.O., D. Colacicco, L. Langner, S. Piper, and G. Schaible. 1990. *Natural Resources and Natural Resource Users Benefit from the Conservation Reserve Program.* U.S. Department of Agriculture, Economic Research Service, AER-627.

Smith, R., G. Schwarz, and R. Alexander. 1997. "Regional interpretation of water-quality monitoring data," *Water Resources Research*, 33(12): 2781-2798.

U.S. Department of Agriculture. 2006. 2*007 Farm Bill Theme Papers: Conservation and the Environment.* Available at: www.usda.gov/documents/FarmBill07consenv.pdf.

Williams, J.R., J.W. Putman, and P.T. Dyke. 1985. "Assessing the Effect of Soil Erosion on Productivity with EPIC." In *Erosion and Soil Productivity*, ASAE Publication 8-85, American Society of Agricultural Engineers, St. Joseph, MO.

Appendix 1: Environmental Index for Green Payments

Indexes are used widely in conservation programs to gauge the potential environmental gain from the application of proposed practices in a specific location. The environmental index described here is designed to capture the potential for environmental gain across a broad range of resource concerns. Resource concerns refers to resource attributes such as water quality, soil quality, and air quality, which are linked to agricultural production through physical effects such as soil erosion, nutrient runoff, and/or pesticide leaching.

Environmental indexes can be specified as indexes of potential environmental gain or environmental performance. For indexes that measure potential gain, a high value denotes higher potential for environmental damage (e.g., water quality damage from nutrient runoff) in the absence of conservation treatment (e.g., nutrient runoff control) or potential for lost opportunity to improve environmental performance in the absence of treatment (e.g., lost opportunity to enhance wildlife populations though habitat enhancement). Indexes of environmental performance are a mirror image: index values are high when there is little opportunity for environmental gain. When nutrient runoff has been controlled through nutrient management or other means, for example, the potential for further environmental gain is low, but environmental performance is high.

In our analysis, we use a performance-based index. Basic index derivations, however, are for a potential gain type index. The two types of indexes can be related as: $S_f = \max(I) - I_f$. Where S_f is the performance-based index value for farm f, I_f is the potential environmental gain-based value for farm f, and $\max(I)$is the largest possible value of I.

For a given farm, the environmental index is an acre-weighted average of components that correspond to various treatments producers can apply to land in specific uses, such as water erosion control on land in crop production (the farm subscript is suppressed to avoid clutter):

$$(1)\quad I = \frac{\sum_k \sum_j A_{kj} I_{kj}}{\sum_k \sum_j A_{kj}}$$

Where

A_{kj} is the number of acres eligible for treatment k on land in use j;

I_{kj} is the index component representing the potential environmental damages or benefits that could be mitigated through application of treatment k on land in use j.

Each index component is the weighted sum of subcomponents representing the potential for damage from the physical effects (m) that could be addressed by applying treatment k on land in use j:

$$I_{kj} = \sum_{m \in k} w_{jm} N_{jm}$$

Where
m indexes physical effects;

w_{jm} is the index weight for land use j and physical effect m;

N_{jm} is the normalized index subcomponent for land use j and physical effect m;

The treatment index (k) is not used at the subcomponent level because each corresponds to a specific physical effect which, in turn, corresponds to only one treatment (although a treatment can correspond to more than one physical effect).

Finally, the basic building block of each index subcomponent (each N) is the relative damage (or benefit) estimate or RDE. Each RDE is the product of variables that describe (1) the intensity of the relevant physical effect (on the individual field) and (2) the potential for that physical effect to cause environmental damage:

$$RDE_{mj} = E_{mj} D_{mj}$$

Where

E_{mj} is the intensity of the physical effect m on land in use j;

D_{mj} is the potential damage associated with the physical effect m on land use j.

The index subcomponents are a normalization of the RDE, see page 33.

Intensity of Physical Effects (E)

The intensity variable generally measures the on-field risk for adverse physical effects such as soil erosion or nutrient runoff.

Wind Erosion: Intensity is measured as the average estimated excess wind erosion (wind erosion in excess of T) per acre for land that has excess erosion, by county. Estimates of wind erosion and the soil loss tolerance (T) are obtained from the National Resources Inventory (NRI). NRI is an area-based survey of land conducted by USDA's Natural Resources Conservation Service (NRCS) in cooperation with Iowa State University. NRI provides information on land use, land characteristics, and land condition (including estimated erosion rates), for about 800,000 points of non-Federal land across all U.S. counties, except those in Alaska.

Water Erosion: Intensity is measured as the average estimated excess water erosion (water erosion in excess of T) per acre for land that has excess erosion, by county. Estimates of water erosion and the soil loss tolerance (T) are obtained from the NRI.

Table A1.1

Intensity and damage variables, by index component and subcomponent

Component (treatment (k) and land use (j))	Subcomponent (physical effect (m))	Intensity	Damage
Wind erosion (cropland)	Dust	Excess erosion, NRI[1]	$/ton of erosion, ERS
	Soil productivity	Excess erosion, NRI	$/ton of erosion, ERS
Water erosion (cropland)	Sediment	Excess erosion, NRI	$/ton of erosion, ERS
	Soil productivity	Excess erosion, NRI	$/ton of erosion, ERS
Nutrient management (cropland)	Nitrogen leaching	NRI-based index	NA[2]
	Nitrogen runoff	NRI-based index	Transport to estuary, USGS SPARROW[3]
	Phosphorous runoff	NRI-based index	NA
Pest management (cropland)	Pesticide leaching	Index of pesticide concentration in water leaching below root zone[4]	NA
	Pesticide runoff	Index of pesticide concentration in runoff[4]	NA
Grazing land health (grazing land)	Grazing land health	Index of potential productivity improvement[5]	NA
Nutrient mgmt and riparian erosion (grazing land)	Nutrient runoff and sediment	Index of nonconfined animals/acre and stream density on grazing land	NA
Wildlife (cropland and grazing land)	Habitat restoration	Number of imperiled species in county[6]	NA

[1]National Resources Inventory (see text for description of NRI data).

[2]NA = data not available

[3]US Geological Survey, Spatially Referenced Regressions of Watershed Attributes. See http://water.usgs.gov/nawqa/sparrow/

[4]Goss et al.

[5]Atwood et al.

[6]Based on NatureServe natural heritage data, see www.NatureServe.org.

Source: USDA, Economic Research Service.

Nutrient Management: Indexes that measure the risk of nitrogen and phosphorous runoff and nitrogen leaching to groundwater are developed using NRI and other data. See appendix 1 in Claassen et al. (2004) for details on the construction of the indexes.

Pest Management: Data obtained from Goss et al., (1998) indicates the number of acres, by watershed (as defined by 8-digit hydrologic unit codes (HUC)), for which pesticide concentration exceeds human health standards in surface runoff and water leaching below the root zone. They also note the number of acres where runoff and leaching contain pesticides in concentrations that are 2 times, 3 times, 5 times, etc., up 25 times, the safe concentration for human health. The intensity measure for pesticides is: $E = \sum_t tc_1$

where t is the number of times pesticide concentration in runoff or leaching exceeds the human health standard and c_t is the number of acres for a given t.

Grazing land health: The grazing measure is based on Atwood et al., (2005). Here pasture productivity is considered a proxy for good grass cover which controls erosion and active weed control which makes it more difficult for invasive species to take hold. The index is calculated as the difference between local (watershed) average forage yields and “high” forage yields (defined as the local mean yield plus two standard deviations of forage yield. In other words, the index measures difference between what is typically obtained versus what could be obtained though superior management.

Nutrient management and riparian erosion on grazing land: The index subcomponent value varies spatially based on the intensity of grazing (number of animal units per acre) and the density of streams relative to grazing land. By county, we estimate the number of grazing animal units and grazing land acreage from the Census of Agriculture. The U.S. Department of Commerce's U.S. Census Bureau conducted the Census of Agriculture for 156 years, 1840-1966. Starting with the 1997 Census of Agriculture, Congress moved that responsibility to USDA's National Agricultural Statistics Service, which collects data in a 5-year cycle for years ending in 2 and 7. Stream density is measured by the average distance of grazing land from perennial streams within counties using National Land Cover Data, National Hydrography Data, and the National Elevation Dataset. The raw index subcomponent is the ratio of stocking density to average distance of grazing land to streams. The higher the stocking density and the shorter the (average) distance to water, the higher the index value.

Wildlife: The wildlife component score is based largely on actions rather than location. Ten percent of index points are based on an intensity variable, defined as the number of potentially imperiled species in the county, as measured by NatureServe (see www.NatureServe.org). The balance of wildlife points are awarded for taking action to improve habitat.

Potential Damages (D)

The damage variable is a measure of the potential for physical effects to cause damage to specific resource attributes such as water quality or soil productivity. These damages may be expressed in monetary terms, may be represented by proxies, or may be absent altogether.

Wind Erosion: Ribaudo et al., (1990) developed measures of the cost of reduced air quality due to particulate pollution caused by wind erosion. Wind-born dust costs include cleaning and maintenance of businesses and households, damage to non-farm machinery, and adverse effects on human health (Piper and Huzar, 1989). Cost per household is modeled as a function of the wind-erosion rate, income, and other household characteristics. The cost model is estimated using contingent valuation techniques and data from a survey of households in New Mexico. The cost model is applied to households west of the Mississippi River using Population Census data and wind erosion estimates. Results are aggregated across households within USDA Farm Production Regions. Damage (benefit) estimates are provided per ton of soil eroded (conserved).

Reductions in soil erosion (for wind or water erosion) will increase the future productivity of farmland. Ribaudo et al., (1990) used yield losses and production-cost increases due to erosion estimated using the Erosion Productivity Impact Model (Williams et al., 1985). The economic value of the gain in productivity is the net current value of the increase in productivity resulting from a marginal reduction in soil erosion.

Water Erosion: The change in consumer surplus associated with water-based recreation due to a change in soil erosion within a watershed is based on Feather and Hellerstein (1997) and Feather et al., 1999). Demand for water-based recreation is estimated using behavioral data from the 1992 National Survey of Recreation and the Environment (NSRE) and soil erosion estimates from the NRI. Demand is modeled as a function of the individual's characteristics, travel costs, erosion levels and other environmental factors. Across the 2,111 HUCs, a 1-ton erosion reduction can increase societal benefits of water-based recreation from 0 to $8.81.

Hansen et al. (2002) estimate the water quality damages of soil erosion within a HUC based on the cost of sediment to downstream navigation. They develop a hydrologic model that accounts for the hydrology and the subsequent flow of sediment within and across watersheds. Their hydrologic model links erosion within a watershed to the downstream cost of dredging harbors and shipping channels. The hydrologic data are from the Environmental Protection Agency's River Reach File, which shows interconnections among 3.2 million miles of streams. Estimates of agricultural erosion by HUC are based on data from the NRI. Dredging-cost data are from the U.S. Army Corps of Engineers. Results show that, across HUCs, a 1-ton reduction in soil erosion can reduce dredging costs from zero to $5.00.

A range of other water quality benefits are obtained from Ribaudo (1990) including:

- *Commercial fishing* benefits, which result from reduced sediment loads in coastal estuaries that serve as breeding grounds for many species;
- *Flooding*-related benefits derive from reduced cost of flood clean up due to reduced sediment concentrations in flood waters;
- *Water conveyance* benefits result from reduced cost of removing sediment from water conveyance facilities, primarily drainage ditches and irrigation canals;
- *Water treatment* benefits are the result of lower water treatment costs due to reduced sediment loads;
- *Municipal and industrial* benefits are due to reduced damage to water-use equipment from minerals, salts, and other materials associated with soil erosion;
- *Steam-electric power plants* that rely on water-cooling benefit from reduced sediment through reduced wear on facilities.

Nutrient Management (nitrogen runoff): Water quality damage due to nitrogen can occur anywhere, but is more common in coastal estuaries where nitrogen, rather than phosphorous, is most often the limiting nutrient in excess algae growth and eutrophication. The likelihood of nitrogen transport to coastal areas is used as a proxy for potential water quality damage. Transport coefficients, which represent an estimate of the proportion of nitrogen runoff that is transported to the coast, were drawn from the SPARROW model developed by U.S. Geological Survey researchers (Smith, Schwartz, and Alexander, 1997).

Normalizing Index Subcomponents

Relative Damage Estimates (RDEs) are normalized to the unit interval:

$$N_{jm} = \frac{\max(RDE_{jm}, P95(RDE_{jm})) - \min(RDE_{jm})}{P95(RDE_{jm}) - \min(RDE_{jm})}.$$

where RDE_{jm} indicates a farm-specific value and $\min(RDE_{jm})$ and $P95(RDE_{jm})$ indicate the minimum and 95^{th} percentile values across all farms, respectively. The 95th percentile is used, rather than the maximum, to prevent outliers in the data from depressing index scores for other farms.

A special consideration applies to the soil productivity component. Because loss of soil depth to wind or water erosion can cause productivity damage, the soil productivity weight is the same for wind and water erosion and is designed to capture the full value of soil loss from both sources. Including independently normalized intensity/damage terms for each would result in double-counting for soil productivity in relation to the normalized intensity/damage terms for sediment runoff or windblown dust. To correct for this possibility, the soil productivity terms are normalized as:

$$0 \le \varphi N_{crop,water} + (1-\varphi) N_{crop,wind} \le 1,$$

where $\varphi = \frac{RDE_{crop,water}}{RED_{crop,water} + RDE_{crop,wind}}$. These additional weighting factors are included with the normalized subcomponents for water and wind erosion.

Index weights

Initial weights are based roughly on the EBI, with points added for the inclusion of grazing land in the model:

- Roughly one-third of points are for soil erosion on cropland. Points are given for potential of erosion control to reduce dust (improve air quality), preserve soil productivity and reduce sediment loads to water.
- Another third are for other water quality-related treatments, including nutrient management and pest management on cropland, nutrient management and riparian erosion on grazing land, and grazing land health.
- Remaining points are for wildlife habitat enhancement (split evenly among all 3 land types).

The weights that are actually used in the model are given in table A1.2.

Table A1.2

Initial index weights

Component (treatment (*k*))	Subcomponent (physical effect (*m*))	Weights		
		Nonirrigated cropland	Irrigated cropland	Grazing land
Wind erosion	Dust	.03	.03	--
	Soil productivity	.10	.10	--
Water erosion	Sediment	.07	.07	--
	Soil productivity	.10	.10	--
Nutrient management	Nitrogen leaching	.04	.04	--
	Nitrogen runoff	.04	.04	--
	Phosphorous runoff	.04	.04	--
Pest management	Pesticide leaching	.04	.04	--
	Pesticide runoff	.04	.04	--
Grazing land health	Grazing land health	--	--	.06
Nutrient management and riparian erosion	Nutrient and sediment grazing land	--	--	.14
Wildlife	Habitat restoration	.20	.20	.20
Totals		.70	.70	.40

Source: USDA, Economic Research Service.

Appendix 2: Acres Eligible for Treatment

For most physical effects modeled, land is eligible for treatment if the severity of one or more physical effects exceeds a predetermined threshold level. For example, land is eligible for soil conservation treatment where soil erosion exceeds the soil loss tolerance or "T" level.[1] Other physical effects are listed in table 1 in the main text. This appendix describes the data sources and our approach to linking data on conservation treatment needs to ARMS farms.

[1]While "T" is generally associated with soil productivity, we use it as a more general threshold for treatment. That is due to practical considerations; treatment for soil erosion concerns has typically meant treatment to the T level in USDA programs from which cost data are drawn.

Eligibility doesn't mean that the producer will undertake any specific treatment or that he/she will receive a payment for it, only that the treatment is appropriate for the land in question. Decisions about whether land will be treated depend on whether the producer is willing to accept the level of payment offered in exchange for treating the land.

Total acreage eligible for treatment is estimated to be 829 million acres (table A2.1). Because one actual acre can be eligible for more than one treatment, some acres are counted more than once. For example, if a single acre of nonirrigated cropland is eligible for nutrient management and soil erosion control, it would be counted twice in table A2.1. Thus, total actual acreage that could receive one or more treatments is less than 829 million acres.

Data and Estimation

Basic land use data, by farm, is from ARMS, phase 3, for 2002. The 2002 survey provides a full accounting of all land uses (e.g., crop production,

Table A2.1

Treatable acres by land use and treatment

Land use	Treatment	Acres (millions)[1]
Nonirrigated cropland	Water erosion control	52.00
Nonirrigated cropland	Wind erosion control	26.77
Nonirrigated cropland	Wind and water erosion control	2.51
Nonirrigated cropland	Nutrient management	280.48
Nonirrigated cropland	Pest management	109.39
Nonirrigated cropland	Wildlife habitat enhancement	4.59
Irrigated cropland	Water erosion control	2.03
Irrigated cropland	Wind erosion control	4.31
Irrigated cropland	Wind and water erosion control	0.28
Irrigated cropland	Nutrient management	49.86
Irrigated cropland	Pest management	17.27
Irrigated cropland	Wildlife habitat enhancement	0.47
Grazing land	Grazing land health enhancement	218.91
Grazing land	Nutrient management and riparian erosion control	44.62
Grazing land	Wildlife habitat enhancement	15.78
All grazing land	All	279.32
All irrigated cropland	All	74.22
All nonirrigated cropland	All	475.74
All treatable acres	All	829.27

[1]Total acres treated will be less than 829 million because some actual acres are eligible for more than one treatment.

Source: USDA, Economic Research Service.

grazing) on each farm in the survey. Data on soil erosion, potential pesticide loss, and other physical effects, however, is not collected with the ARMS data. Other data are used to estimate the proportion of acres needing treatment for a specific physical effect in the county or watershed that includes the farm (table A2.2). That information is used together with farm-specific acreages to estimate acres eligible for treatment:

$$A_{kj} = A_j P_{kj}$$

where:

A_{kj} is farm-specific acreage estimated to need treatment k on land in use j;

A_j is farm-specific acreage in land use j; and,

P_{kj} is the proportion of acres in need of treatment k on land in use j in the surrounding area.

Soil erosion (wind and water): Cropland acres are eligible for soil conservation treatment if estimated average annual erosion (wind or water) exceeds the soil loss tolerance (T) value for the land. The proportion of acres eligible for treatment, by county, is estimated from the NRI, which provides estimates of soil erosion rates, T-values, and acreage for all cropland sample points.

Nutrient runoff and leaching: All cropland acres are eligible for treatment for nutrient runoff and leaching. This assumption reflects the fact that excess nutrient balances and nutrient loss to water are widespread problems and thresholds for nutrient treatment are not clearly defined.

Pesticide runoff and leaching: Cropland acres are eligible for pesticide management if water leaving the field, either through surface or subsurface flows, is estimated to contain pesticides in concentrations that exceed standards for the protection of human health. Estimates of the number of acres by watershed (8-digit HUC) are obtained from Goss, et al.

Cropland habitat acres: Acreage eligible for habitat enhancement, by county, is from the NRCS Workload Assessment (WLA). WLA provides the acreage of various land types (e.g., cropland, grazing land) where conservation treatment for various physical effects would be appropriate. WLA estimates are based on the expert judgment of the local NRCS staff that assists farmers in determining conservation needs, devising conservation plans, and facilitating conservation practice implementation. To obtain the overall proportion of cropland acres eligible for habitat enhancement, WLA acreages are divided by the appropriate acreage (nonirrigated or irrigated cropland) obtained from the 2002 Census of Agriculture.

Grazing land grass cover, nutrient management, and habitat acres. On grazing land, county-wide estimates of acreage eligible for treatment for poor grass cover, nutrient-related issues, or habitat enhancement are from the WLA. To obtain proportions, WLA acreages are divided by grazing land acreage obtained from the 2002 Census of Agriculture.

On land that could be treated for both water and wind erosion, the cost of treating both is often less the sum of the separate treatments. That's because some practices can used for control of both water and wind erosion. A single practice can do both because wind and water erosion occur under different conditions and often at different times of the year. To avoid double counting the cost of these practices, 3 acreage variables are needed: total acres eligible for water erosion treatment, total acres eligible for wind erosion treatment, and acres eligible for both. Fortunately, the NRI data can provide these estimated. See appendix 3 for more detail on how these acreages are used in estimating treatment cost.

There is also overlap between treatment for N runoff, P runoff, and N leaching. All are addressed by nutrient management (NRCS practice code 590) but could be made up of differing components of the nutrient management practices. Although the plan is typically based on a single nutrient, all nutrients must be used at appropriate rates. So, when a producer undertakes nutrient management, we assume that all nutrients are applied at appropriate rates and otherwise managed in a way consistent with the spirit of the nutrient management plan.

Table A2.2

Definition of acres needing treatment, by physical effect

Treatment	Relevant ARMS acreage	Proportion of acres (county or HUC) needing treatment	Data Source
Wind erosion	Cropland[1]	Proportion of acres with wind erosion > T[2]	NRI
Water erosion	Cropland	Proportion of acres with water erosion > T	NRI
Nutrient management	Cropland	All acres assumed to need treatment	--
Pesticide management	Cropland	Proportion of acres for which pesticide concentration in water leaving field is estimated to exceed human health threshold	Goss et al.
Grazing land health	Grazing land	Grazing acres cited as needing treatment for grazing land health	WLA
Nutrient mgmt and riparian erosion	Grazing land	Grazing acres cited as needing treatment for nutrient-related concerns or soil erosion	WLA
Habitat restoration/ wildlife management	Cropland	Cropland acres cited as needing treatment for wildlife concerns	WLA
	Grazing land	Grazing acres cited as needing treatment for wildlife concerns	WLA

[1]Nonirrigated and irrigated cropland are treated separately in the analysis.

[2]While the T factor is based on the potential for productivity loss and not water quality, per se, it is reasonable to assume that full treatment has been achieved when soil erosion is reduced to T.

Source: USDA, Economic Research Service.

Appendix 3: Producer Economic Cost/ Willingness to Accept (WTA)

A producers' willingness to accept (WTA) is the minimum payment he or she would accept in exchange for taking a specific action, such as undertaking a given conservation treatment. WTA depends on a range of factors including (but not necessarily limited to) out-of-pocket costs (or savings), changes in production (positive or negative), changes in production risk, and the level of management skill required for successful implementation. For a given offer of payment in exchange for taking a specified action, a producer will accept the payment (apply for the programs in question) if the payment is equal to or larger than the producer's WTA.

In the text, we often refer to WTA as "economic cost" because WTA represents a producer's cost of applying conservation practices is a very broad sense of the term cost. Economic cost includes everything farmers must pay for (out-of-pocket expenses), but also includes things that are real but more difficult to estimate with precision. For example, producers may need to manage fertilizer applications more carefully to comply with terms of a nutrient management plan. This "hassle factor" is a real cost to the producer, but is hard to value in monetary terms.

In general, WTA is private information. Producers know what payment they would be willing to accept while policymakers and program managers do not. For model development, EQIP payments are used as a proxy for WTA. EQIP participants have shown that they are willing to accept the contract payment in exchange for adopting or installing practices specified in the contract. The EQIP payment is only a proxy because participants may also have been willing to accept lower payments. Moreover, producers who are not EQIP participants may or may not be willing to accept this same level of payment in exchange for taking similar actions. In the absence of other data, however, we assume that EQIP payments can serve as a reasonable proxy for WTA.

Information on the distribution of WTA across farms is given in table A3.1. For each land use and treatment combination, we provide a national average per acre WTA as well as the 5^{th}, 25^{th}, 50^{th}, 75^{th}, and 95^{th} percentiles. For example, WTA for water erosion control on nonirrigated cropland averaged \$58 per acre, but 5 percent of acres that are eligible for this treatment can be treated for \$16.28 or less, 25 percent of acres can be treated for \$29.79 or less, and so on. Note that even though average per-acre WTA is higher for grazing land health (\$81.56) than for water erosion on non-irrigated cropland (\$58.04), a substantial share of grazing land could be treated for grazing land health at a relatively low cost: 25 percent of eligible acres have WTA estimates of \$17.12 per acre or less while the same percentage of land eligible for water erosion control has WTA of \$29.79 or less.

Data and Estimation

We estimate WTA as the average payment per treated acre for a suite of practices typically employed in addressing a specific physical effect in a given watershed (8-digit HUC). For example, conservation tillage, terraces, and contour farming, among other practices, are widely used to control the

Table A3.1

Distribution of willingness to accept payment (WTA) across modeled farms

Land use	Treatment	Percentiles 5	25	50	75	95	Average
		Dollars per acre					
Nonirrigated crop	Water erosion control	16.28	29.79	46.76	75.02	137.20	58.04
Nonirrigated crop	Wind erosion control	7.39	19.73	26.82	38.77	62.27	30.40
Nonirrigated crop	Nutrient management	3.28	9.11	12.90	16.18	26.98	13.62
Nonirrigated crop	Pest management	4.75	10.37	12.52	17.02	58.49	20.02
Nonirrigated crop	Habitat restore/enhance	4.20	12.73	16.22	27.47	55.73	22.93
Irrigated cropland	Water erosion control	7.48	23.29	35.81	55.32	107.63	44.17
Irrigated cropland	Wind erosion control	3.61	16.17	27.27	40.36	61.70	28.33
Irrigated cropland	Nutrient management	2.66	7.15	13.13	16.37	41.55	14.91
Irrigated cropland	Pesticide management	3.37	9.24	13.33	31.99	75.64	26.91
Irrigated cropland	Habitat restore/enhance	2.94	8.74	12.42	12.73	46.83	13.91
Grazing land	Grazing land health	5.82	17.12	49.12	105.45	281.75	81.56
Grazing land	Nutrient management and riparian erosion control	7.21	20.03	36.77	93.33	279.79	79.27
Grazing land	Habitat restore/enhance	2.81	7.11	19.59	40.56	80.65	29.08

Source: USDA, Economic Research Service.

physical effect sheet and rill erosion (details below). By focusing on specific areas, our WTA estimates reflect both the frequency with which specific practices are used and the out-of-pocket cost, etc., of applying those practices in that area. The 8-digit HUC was selected as the unit area because they are large enough to contain a substantial number of observations but small enough to capture both spatial diversity in the exact mix of practices used to treat a given physical effect and variation in the payment needed to leverage the application of these practices. In areas where data are sparse, some WTA estimates are calculated for larger watersheds.

A first step in calculating estimates of WTA is to identify practices that could be used to treat specific physical effects. Table 1 in the main text shows how treatments are linked to land use, physical effects, and resource concerns.

Cropland: Table A3.2 shows which practices are assigned to each treatments to estimate WTA. These groupings are drawn largely from Atwood, et al., 2003 and Atwood, et al., 2005. Grouping practices this way is not meant to infer that every farm would use every practice on every acre when addressing a specific physical effect. Rather, the WTA estimate for a given practice group in a given HUC reflects the frequency with which each practice within the group is used and local cost of applying these practices. For example, if conservation tillage is used frequently for soil erosion control in a given HUC while seasonal residue management is not used, the cost per acre will reflect the fact that conservation tillage is locally adapted while seasonal residue management is not.

The calculation of WTA must also consider whether individual practices can simultaneously treat more than one physical effect. Many soil erosion control practices can reduce both wind and water erosion. Because wind and water erosion occur under different conditions, the same practice can be effective for both. Water erosion occurs during storm events when wind erosion is not a hazard, while wind erosion occurs when the soil surface is dry when water erosion is not a hazard. If both types of erosion control are needed, simply adding the estimated WTA for water and wind erosion control could lead to double-counting because some practices, included in estimates for both wind and water erosion control, would be applied only once. To account for this possibility, we define practices that are commonly used to address both wind and water erosion and the cost-savings if both are addressed on the same land.

Grazing land: A two-level screen is used to identify practices for grazing land treatments. First, we establish a set of practices that are commonly used on grazing land (table A3.3). Our list is drawn largely from Atwood et al., 2003 and Atwood et al., 2005 and augmented by information drawn from EQIP contract data (table A3.3). We assume that grazing land health is addressed by one of the practices on our list whenever it is associated with one of these NRCS classification codes[1]:

- Excessive erosion (PG1);
- Invasion of noxious weeds (PG2);
- Invasion of woody species (PG3);
- Other grazing land health issues (PG4);
- Loss of plant diversity – declining species (PP1);
- Plants not adapted to site (PP3);
- Insufficient water supply for livestock (WQ6).

For nutrient management and riparian erosion control, a similar set of practices is used (there is significant overlap), but practices are counted only when they appear with these NRCS classification codes:

- Animal waste, organics, and pathogens (WS2);
- Loss of riparian vegetation (WS6);
- Stream bank and shoreline erosion (WS8);
- Loss or degradation of riparian vegetation (PP2);
- Stream bank and shoreline erosion (PP4).

Because we cannot determine whether grazing land health concerns occur on the same acres as water quality concerns, we do not estimate payments to practices that address both. We do, however, exclude nutrient management practices where they are paired with livestock practices that involve waste handling structures and equipment typically found on large farms with confined animals. We exclude these contracts because they are more likely to reflect nutrient management costs on confined animal feeding operations (which is not our focus) than on grazing land (which is our focus).

Wildlife: We assume that wildlife habitat on working agricultural lands will be addressed primarily through use of Upland Wildlife Habitat Management

[1]NRCS refers to these as resource concerns. Because we have used the term “resource concern” to refer to the broader concerns of “water quality” or “air quality,” we refer to these as NRCS classification codes to avoid confusion.

(NRCS practice code 645) and associated practices (listed in the national practice standard for Upland Wildlife Habitat Management, see table A3.4). When these associated practices occur in conjunction with any habitat-related NRCS classification code, they are used in the estimation of WTA for wildlife-related treatment. Some practices are assumed to be used only on grazing land acres (e.g., range planting), while we assume that others could be used on either cropland or grazing land (see table A3.4). Again, because we cannot determine whether wildlife concerns occur on the same acres as other physical effects, we do not estimate payments to practices that address wildlife in conjunction with other physical effects or resource concerns.

EQIP contract data for 2003-05 are used. All dollar amounts are adjusted to the beginning of fiscal year 2007 (October 1, 2006 through September 30, 2007) using the Gross Domestic Product (GDP) implicit price deflator. We also treat structural or vegetative practices differently from management practices due to differences in implementation. For structural and vegetative practices, EQIP payments are in the form of cost-sharing on actual (one-time) installation costs. For management practices, which must be re-applied each year, EQIP participants receive annual incentive payments for a 3-year period. These payments are designed to smooth the transition to the use of new management practices. Our estimate of WTA for specific practices is based on the cost-share payment to structural or vegetative practices, or the net present value of 3 years' worth of incentive payments on management practices. Discounting future costs at a rate of 7 percent, the net present value of the transition payment is equal to the annual payment times 2.62.

EQIP contract data indicates which practices have been used on a specific tract of land, how those practices were classified by NRCS, and the total number of acres treated (in all tracts associated with a given contract). Tract size is estimated as the total treated acres for the entire contract divided by the total number of tracts listed in the contract. Using this data, we calculate the average payment per acre for treating a specific physical effect as:

$c^s_{kj} = \frac{\sum_{h\in k}\sum_g\sum_t x^s_{hgjt}}{\sum_g z_g}$ for structural/vegetative practices and $c^m_{kj} = \frac{\sum_{h\in k}\sum_g\sum_t d\,x^m_{hgjt}}{\sum_g z_g}$ for management practices where

x^s_{hgjt} is expenditure for structural or vegetative practice *h* on tract g in use *j* at time *t* (already adjusted to 2007 dollars);

x^m_{hgjt} is expenditure for management practice *h* on tract g in use *j* at time *t* (already adjusted to 2007 dollars);

z_g is acreage in tract *g*;

d is a discount factor $d = r^{-1}(1-(1+r)^{-T}$ where r is the interest rate and T is the number of years the payment is made (d=2.62 for 7 percent discount rate over 3 years).

Note that location subscripts are suppressed to avoid clutter.

Formally, then, our estimate of WTA for treatment k on land in use j can be written as:

$$a_{kj}c_{kj} = a_{kj}(c_{kj}^{s} + c_{kj}^{m})$$

where a_{kj} is the number of treated acres. When practices overlap treatments (only between wind and water erosion) we define WTA as:

$$a_{kj}c_{kj} + a_{k'j}c_{k'j} - a_{kk'j}c_{kk'j}$$

$c_{kk'j}$ is the average EQIP expenditure, per treated acre, for practices in both group k and group k' on land use j;

$a_{kk'j}$ is the acreage that needs treatment practices in groups k and k' on land use j;

Again, note that estimates vary by HUC, but location subscripts are suppressed to avoid clutter.

Table A3.2

Practices for cropland

Code	Management	Practice name
Sheet and rill erosion only		
311	no	Alley cropping
330	yes	Contour farming
331	yes	Contour Orchard and other fruit area
386	no	Field border
410	no	Grade stabilization structure
585	yes	Contour strip-cropping
600	no	Terrace
638	no	Water and sediment control
716	yes	Anion polyacrylamide (PAM) erosion control.
741	no	Vegetative buffer strips
Wind erosion only		
380	no	Windbreak/shelterbelt establishment
392	no	Field windbreak
422A	no	Herbaceous wind barriers
422	no	Hedgerow planting
589A		yes Cross-wind ridges
589B	yes	Cross wind strip-cropping
589C	yes	Cross wind trap strips
609	yes	Surface roughening
612	no	Tree/shrub establishment
650	no	Windbreak/shelterbelt renovation
704	no	Agroforestry planting
Both sheet & rill and wind erosion		
328	yes	Conservation crop rotation
329A	yes	Residue management, no-till and strip till
329B	yes	Residue management, mulch till
329C	yes	Residue management, ridge till
340	yes	Cover crop
342	no	Critical area planting
344	yes	Residue management, seasonal
586	yes	Strip-cropping
758	yes	Strip–intercropping
Nutrient runoff/ leaching only		
590	yes	Nutrient management
Pesticide runoff/ leaching only		
595	yes	Pest management

Source: USDA Economic Research Service.

Table A3.3
Practices for grazing land

Code	Management	Practice name
Grazing land health only		
314	no	Brush management
338	yes	Prescribed burning
380	no	Windbreak/shelterbelt establishment
460	no	Land clearing
510	yes	Pasture and hayland management
512	no	Pasture and hay planting
528A	yes	Prescribed grazing
548	yes	Grazing land mechanical treatment
550	no	Range planting
612	no	Tree/shrub establishment
650	no	Windbreak/shelterbelt renovation
Water quality only		
590	yes	Nutrient management
Grazing land health and water quality		
382	no	Fence
472	no	Use exclusion
561	no	Heavy use area protection
574	no	Spring development
575	no	Animal trails and walkways
578	no	Stream crossing
614	no	Trough or tank
762	yes	Planned grazing system

Source: USDA Economic Research Service

Table A3.4
Practices for wildlife management

Code	Management	Practice name
Practices for use on grazing land		
338	yes	Prescribed burning
472	no	Use exclusion
512	no	Pasture and hay planting
528A	yes	Prescribed grazing
550	no	Range planting
612	no	Tree/shrub establishment
Practices for use on any land		
390	no	Riparian herbaceous cover
511	yes	Forage harvest management
643	no	Restoration of rare/declining habitat
645	yes	Upland wildlife management
647	no	Early successional habitat development
648	no	Wildlife watering facility

Source: USDA Economic Research Service.

Appendix 4: Producer Decision Rules

Because participation is voluntary, producers respond to the offer of green payments by deciding whether and how to participate. We assume that producers participate only when the overall payment exceeds WTA[1] plus a minimum return that accounts for transaction costs. We assume transaction costs of $200 per farm in our analysis and test the sensitivity of results to changes in this threshold. When more than one participation option meets participation decision criteria, farms are assumed to select the one that yields the largest net return (payment less WTA).

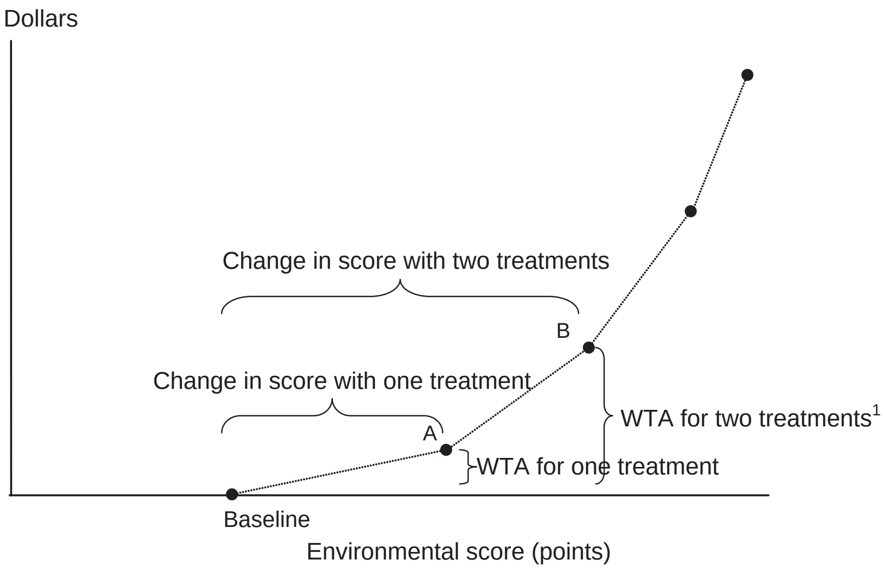
For scenarios that use the environmental index including *Improved Performance, Good Performance,* and *Modified Compliance*, program offers and decision rules are illustrated graphically. In response to any performance-based incentive, producers will first choose the treatment that yields the largest number of environmental points (most performance) per dollar of WTA. In figure A4.1, that treatment is illustrated by point A. Next, the producer would consider treatment for the physical effect with the next-best combination of points and WTA (point B in figure A4.1), and so on. The points form a curve that can be thought of as the producers "supply" of conservation treatments.

This supply curve, combined with information on payments, determines which conservation treatments a producer will undertake. In the *Improved Performance* scenario, producers are paid on a per-point basis, starting at the producer's own baseline (pre-program environmental performance). In figure A4.2, the slope of the payment line represents the payment rate (dollars per environmental point). The distance between the payment line and the hori-

[1]In the text WTA is ofen refered to as economic cost.

Figure A4.1

Farm-level "supply" of conservation treatments

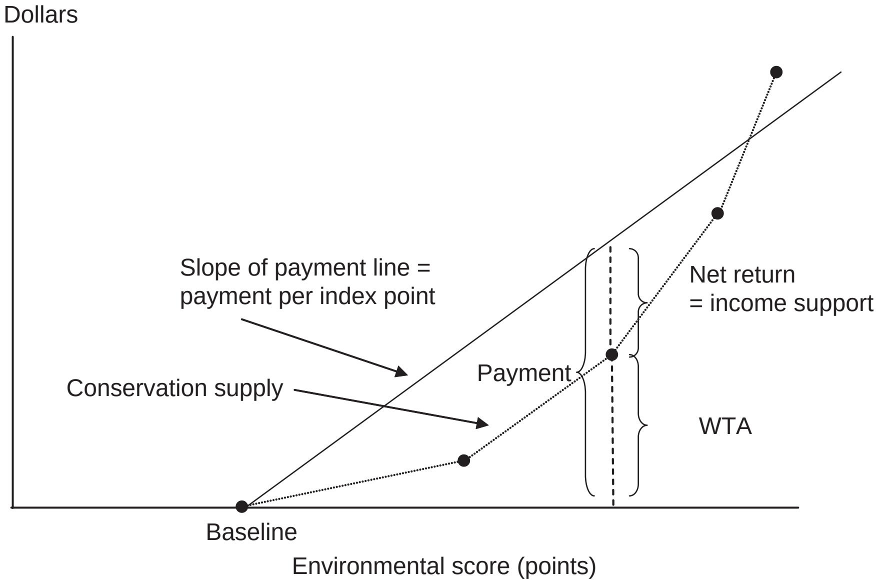


[1]WTA is defined as a producer's willingness to accept—the minimum payment he or she would accept in exchange for taking a specific action (e.g., undertaking a given conservation treatment).

Source: USDA, Economic Research Service.

Figure A4.2

Decision rule for the *Improved Performance* scenario



Source: USDA, Economic Research Service.

zontal axis represents the payment amount and the distance between the points on the supply curve and the payment line represents the producer's net gain or income support, that is, the amount paid over and above the WTA for adopting environmentally sound practices. Given our assumption about producer behavior, they will choose the option with the largest net return.

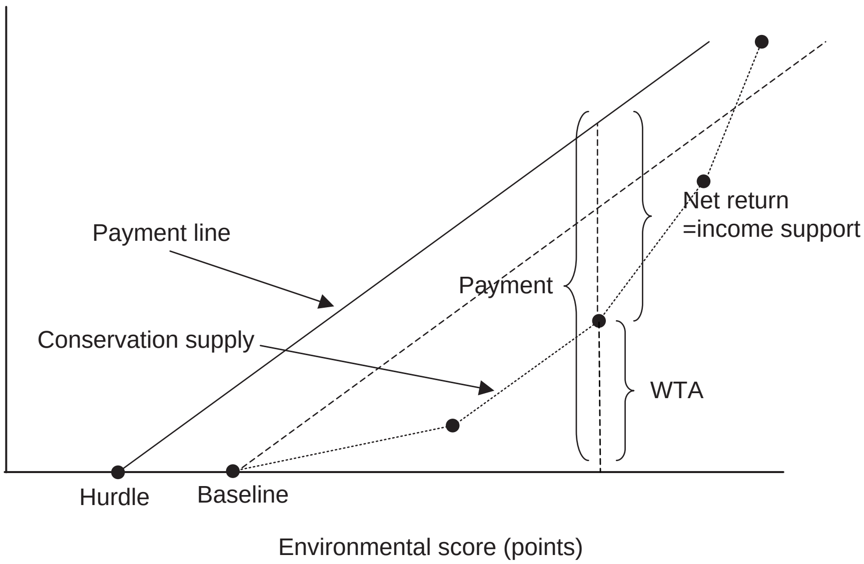
In the *Good Performance* scenario, producers receive payments based on their performance relative an environmental hurdle rate rather than a farm-specific baseline (fig. A4.3). If a given farm's baseline is above the hurdle (that is, the baseline is to the right of the hurdle as measured on the horizontal axis in figure A4.3), the producer receives a payment larger than could be earned under the *Improved Performance* scenario. Note that other producers, who have baselines below the hurdle rate (the baseline is to the left of the hurdle rate on the horizontal axis in figure A4.3), would be eligible for payments that are less than they would receive from the *Improved Performance* scenario. These producers may still participate, although their net return (income support) will be less than it would have been under *Improved Performance*. Thus, income support in *Good Performance* is focused on those producers who have already achieved a high level of environmental performance.

Finally, the *Modified Compliance* decision rule can also be depicted graphically as well (fig. A4.4). The maximum payment is similar to the existing direct payments. Producers can receive 20 percent of their maximum payment even if they take no action to address additional environmental concerns. Producers receive 100 percent of their maximum payment if they address all remaining concerns. If the producer addresses only a portion of remaining concerns, the payment is pro-rated according to the proportion of remaining concerns that are addressed (as measured by the environmental index).

Figure A4.3

Decision rule for *Good Performance* scenario when producer baseline exceeds hurdle rate

Dollars

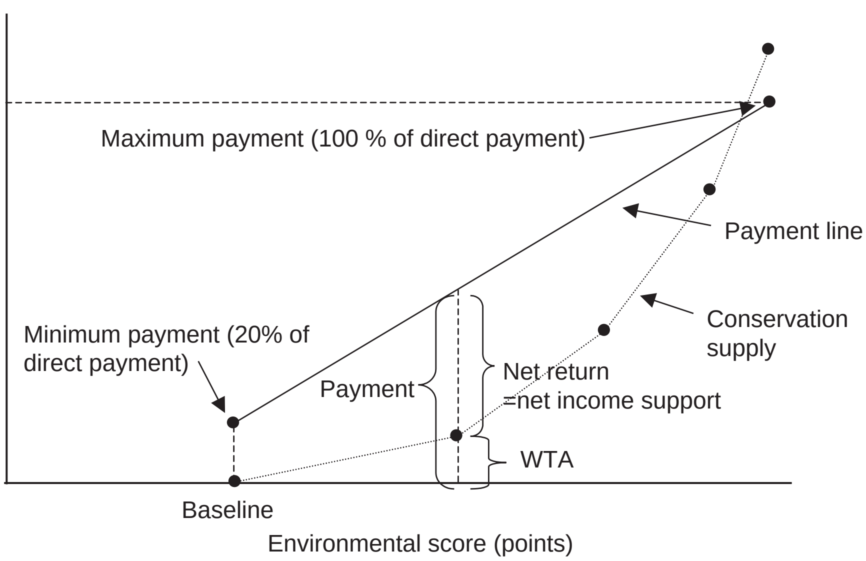


Source: USDA, Economic Research Service.

Figure A4.4

Decision rule for *Modified Compliance* scenario

Dollars



Source: USDA, Economic Research Service.

Appendix 5: Sensitivity Analysis

We test model sensitivity to a number of economic and policy parameters selected for the main analysis:

- The minimum net return (which stands in for transactions cost);
- Environmental index weights; and
- Hurdle rates selected for the *Good Performance* scenario.

For the minimum net return and environmental index weights analyses, we use the *Improved Performance* scenario. In each of these sensitivity analyses, we attempt to hold overall program payments constant at about $15 billion over 5 years ($3 billion per year).

Sensitivity of Minimum Net Return

Producers do not have an economic incentive to participate in a green payments program unless participation results in a minimum return that at least covers transaction costs. These costs could include time and travel involved in filling out applications, verifying existing environmental performance, and working with conservation technicians to develop plans for additional conservation. In our initial analysis, a minimum return of $200 per farm was required to trigger program participation. We tested the sensitivity of model results to higher minimums over an extremely wide range, up to nearly $8,000 per farm.

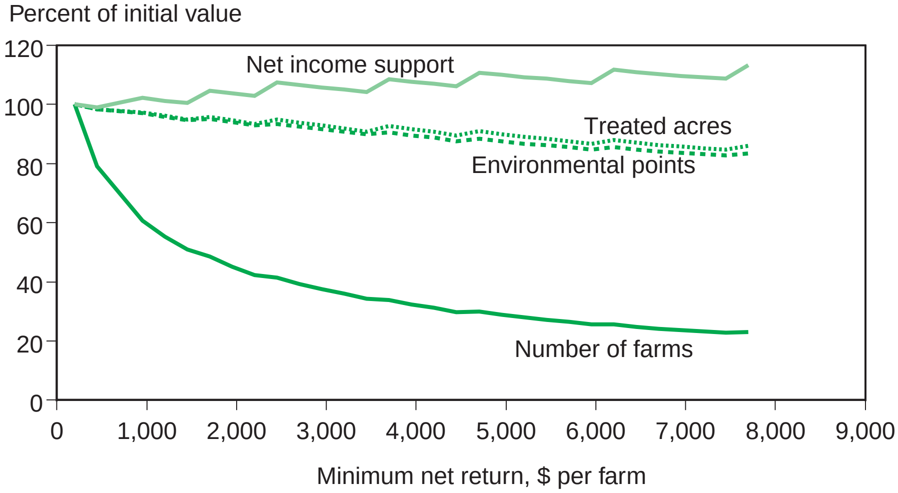
Figure A5.1 shows that higher minimum returns could substantially reduce the number of farms that are estimated to participate, but would make much less difference in terms of treated acreage, environmental points, and net income support. When the minimum net return is $1,000, estimated participation (farms) drops by 40 percent, while change in other measures of program performance are 3 percent or less. Treated acreage and environmental points decline slightly, while overall net income support increases slightly. For larger minimums, the decline in participation slows while treated acreage and environmental points continue to decline slowly and net income support continues to increase slowly.

Sensitivity of Index Weights

Index weights determine the relative importance of various environmental problems and, because payments are based in part on environmental scores, can exert a strong influence on which conservation treatments are actually undertaken. To get some sense of how much index weights influence outcomes, we test the sensitivity of the model to changes in index weights. For the sensitivity analysis, we place each index component (and all associated subcomponents) into one of four categories: soil erosion, water quality, grazing land health, and wildlife habitat (table A5.1). For each category, we re-estimate the model doubling weights in one category while weights in other categories are reduced, in total, by an equal amount. Weights are reduced in proportion to the original weight for each subcomponent. The procedure ensures that the total number of possible points is unchanged and

Figure A5.1

Effect of increasing minimum net return, improved performance scenario



Source: USDA, Economic Research Service.

Table A5.1

Index component grouping for sensitivity analysis

Group	Index components	Combined weight
Grazing land health	Grazing land health	.06
Soil erosion	Wind erosion (cropland)	.60
	Water erosion (cropland)	
Water quality	Nutrient management (cropland)	
	Pest management (cropland)	.54
	Nutrient management and Riparian erosion (grazing land)	
Wildlife habitat	Wildlife habitat (all land)	.60

Source: USDA Economic Research Service.

that the relationship among model subcomponents (ones for which weights are not doubled) is unchanged.

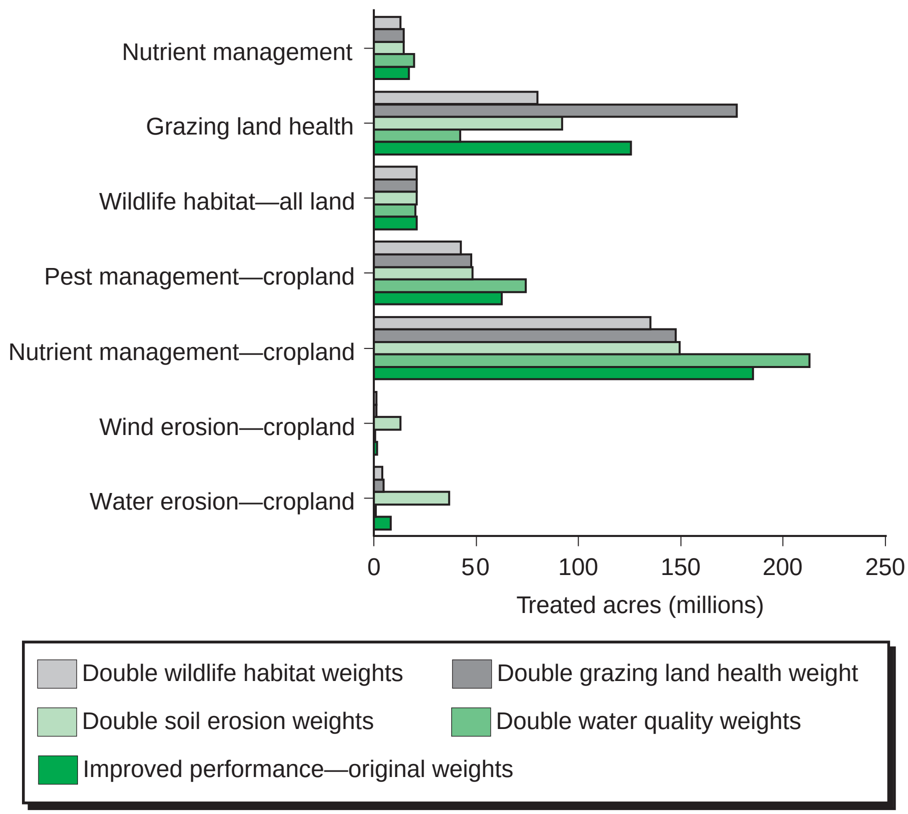
National results show that the effect of doubling index weights for component groups varies. For grazing land health, doubling the component weight would increase the overall number of acres treated and the overall number of environmental points earned (fig. A5.2). More specifically, the number of acres treated for grazing land health would increase from about 125 million with the base weights to about 175 million with the grazing land health index weight doubled. This result follows from the fact that a large acreage is eligible for grazing land health treatment (about 220 million acres; see table A2.1 in appendix 2), but many of those acres would be costly to treat (median WTA is about $50 per acre—the highest of any treatment; see table A3.1 in appendix 3). So, higher payments that come with a higher score make a significant difference in the number of acres treated. The increase in acreage treated and environmental points earned for grazing land health are larger than decreases associated with other treatments (where index weights were reduced).

Table A5.2
Sensitivity to change in index weights

	Program payments	Number of farms	Net income support	Treated acres	Environmental points
	Million $	*1,000*	*Million $*	*Millions*	*Millions*
Base weights	14,960	1,132	9,088	411	19
Double grazing land health weight	14,858	1,090	8,563	413	23
Double soil erosion weight	15,082	1,104	8,548	375	12
Double water quality weight	14,930	1,173	9,643	370	27
Double wildlife habitat weight	15,066	996	11,350	296	13

Source: USDA Economic Research Service.

Figure A5.2
Treated acres, sensitivity to change in index weights



Source: USDA, Economic Research Service.

In contrast, doubling the weight on the wildlife habitat index components would reduce overall acreage treated and the overall number of environmental points earned. Doubling the wildlife habitat weights would not result in additional treatment because only a relatively small number of acres are eligible for this treatment to begin with (about 20 million acres; see table A2.1) and nearly all of these acres are treated in the *Improved Performance* scenario with the base weights. Meanwhile, reducing other weights would lower payments to other treatments, reducing treated acreage and environmental points.

In terms of net income support, doubling the weight on the grazing land health component would result in a small overall reduction while doubling the wildlife habitat weight would result in an increase of more than $1 billion in net support. Net income support is increased when the wildlife habitat weight is increased because payments to producers who adopt wildlife-related practices increase even if additional acres can't be treated for wildlife-related concerns.

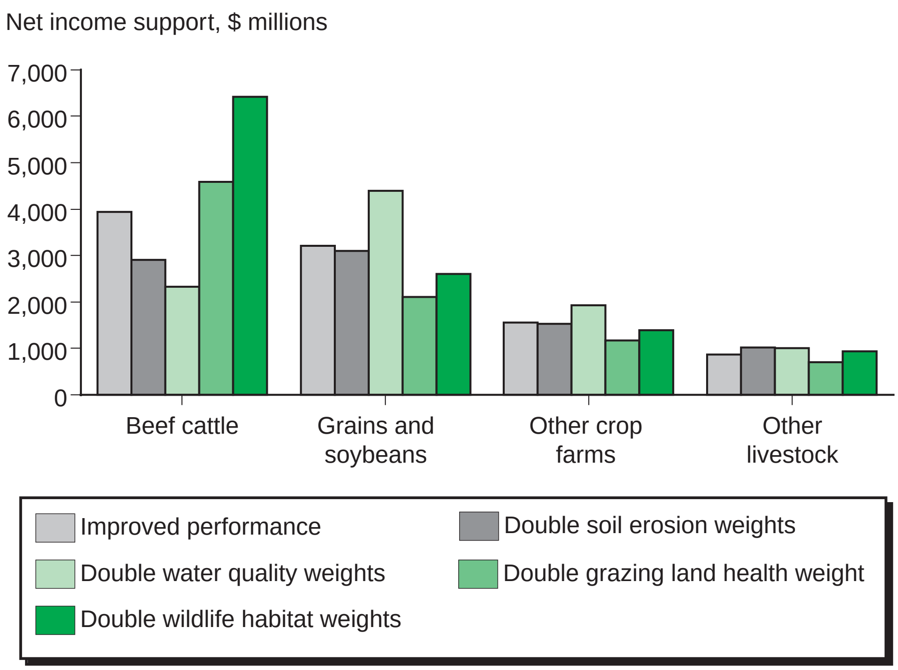
Beef producers gain additional support from increases in the weights for grazing land health and wildlife habitat but lose support when soil erosion or water quality is targeted for increase (fig. A5.3). The situation is different for crop producers: Increases in weight for water quality components increases their income support while increases for grazing land health or wildlife habitat decrease their overall level of income support. Regions with large acreages of grazing land tend to receive greater income support when weights for grazing land health or wildlife habitat are increased (fig. A5.4). Regions with large crop acreages tend to receive more income support when the weight given to water quality is increased.

Sensitivity of Environmental Hurdle Rates

Environmental hurdle rates in the *Good Performance* scenario define environmental performance that is good enough to qualify for some level of payment. Our initial *Good Performance* scenario assumes that hurdle rates are (1) devised on a region-by-region basis and (2) define the hurdle rate in a way that includes farms which account for roughly one-half of all agricul-

Figure A5.3

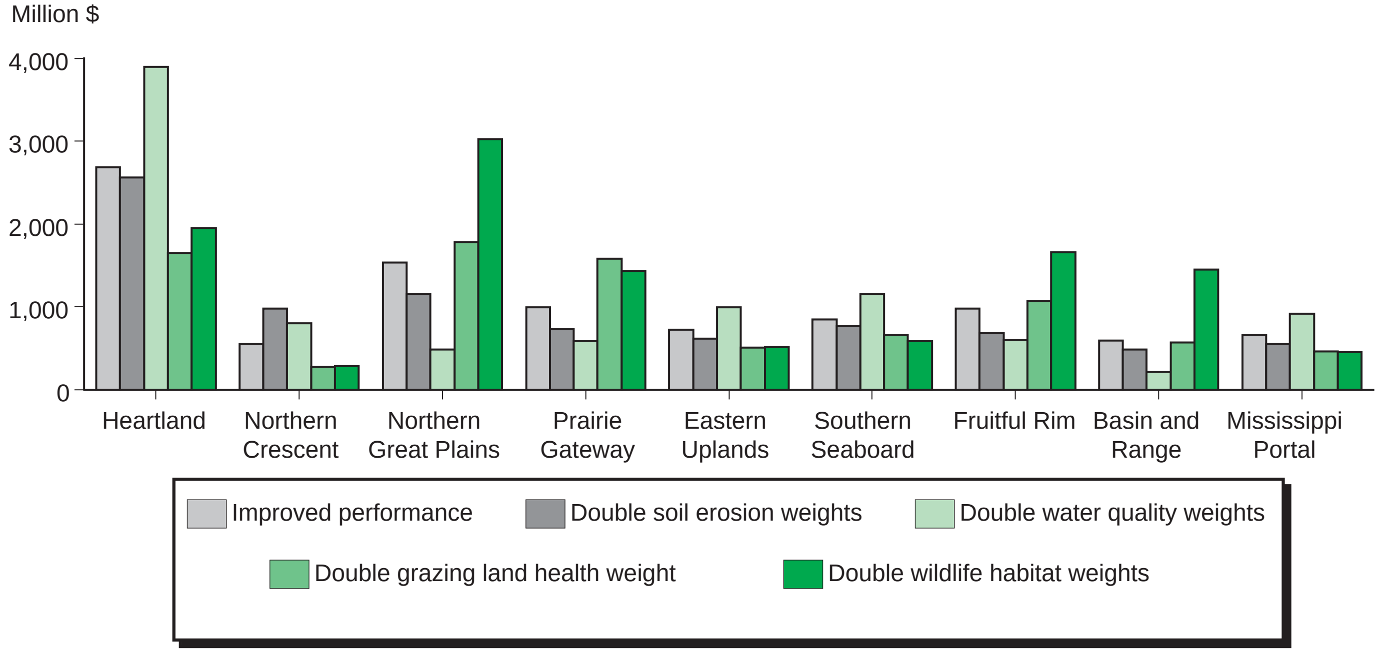
Net income support by scenario and primary commodity—sensitivity to change in index weights



Source: USDA, Economic Research Service.

Figure A5.4

Net income support by scenario and ERS resource region



Source: USDA, Economic Research Service.

tural land. Here, we consider two changes: (1) hurdle rates set for the Nation as a whole and (2) hurdle rates set for varying levels of inclusiveness.

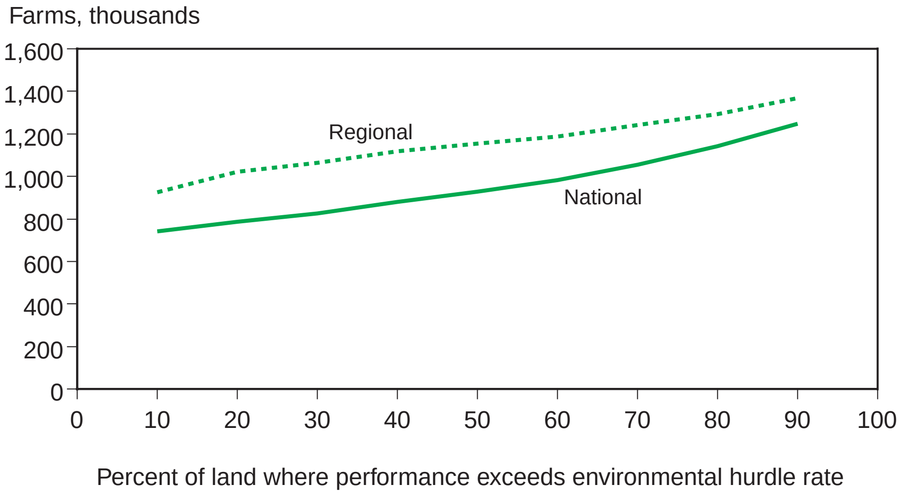
Given a $15 billion budget, the number of participating farms is larger when hurdle rates are calculated at a regional, rather than national level (fig. A5.5). Depending on the level of the hurdle rate (and assuming a $200 minimum per-farm return for participating farms), between 100,000 and 200,000 additional farms participate when hurdle rates are set regionally. As the hurdle rates are adjusted to increase the amount of land in “good actor” status, participation rises with both regionally and nationally defined hurdle rates. As the hurdle rates become increasingly inclusive, participation becomes attractive to a broader group of producers because more producers can participate without taking any additional conservation action or incurring additional cost. Treated acreage, on the other hand, declines rapidly as the hurdle rate becomes more inclusive (fig. A5.6) and more producers can qualify for payments without undertaking additional conservation treatments.

As the budget is increasingly devoted to these good performance payments, less is available for leveraging additional conservation effort. To limit payments to $15 billion, the payment rate must be lower and the number of acres treated declines. Finally, environmental performance, as measured in index points, is largest when hurdle rates are set to include about 30 percent of land but also declines when the environmental hurdle rate is more inclusive (fig. A5.7).

Finally, income support rises as the hurdle become increasingly inclusive (fig. A5.8). Payments for good performance are the key engine of growth for income support. Even as good performance payments rise, however, reduced conservation treatment activity means that income support associated with the "profit" from conservation treatment declines. As a result, net income support rise less than do good performance payments.

Figure A5.5

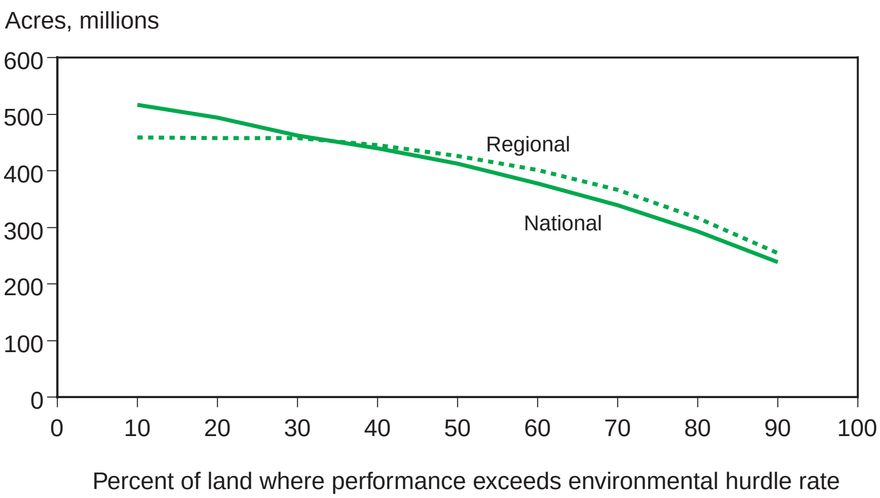
Particpating farms—national and regional hurdle rates



Source: USDA, Economic Research Service.

Figure A5.6

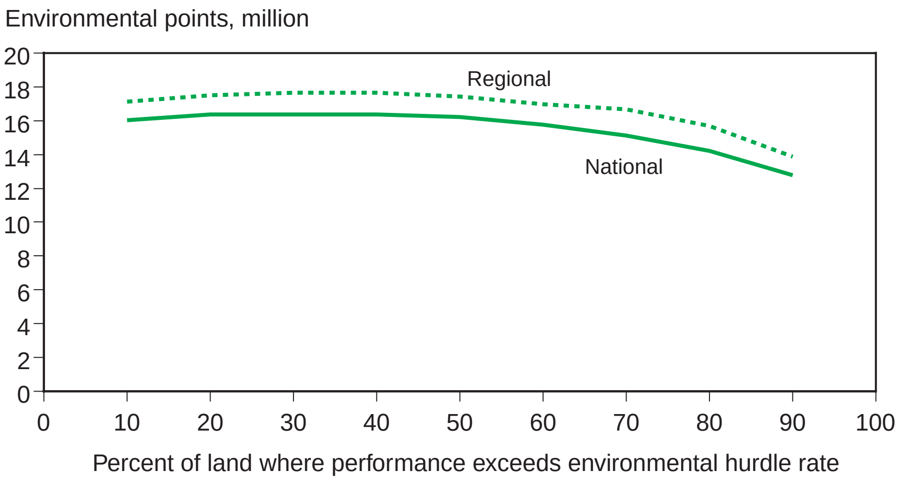
Acres treated—national and regional hurdle rates



Source: USDA, Economic Research Service.

Figure A5.7

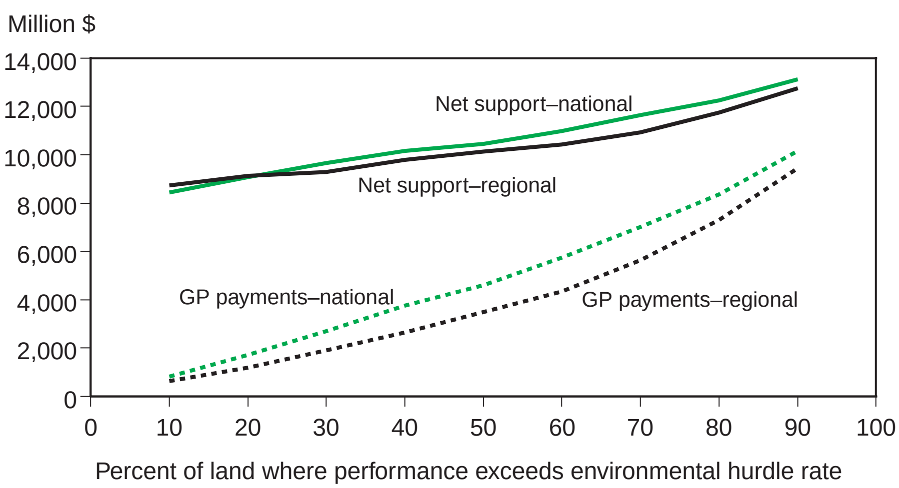
Environmental points—national and regional hurdle rates



Source: USDA, Economic Research Service.

Figure A5.8

Net income support and good performance payments—national and regional hurdle rates



Source: USDA, Economic Research Service.