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Conservation Program Design

Rewarding Farm Practices versus Environmental Performance

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Implementing conservation payment programs requires decisions about what actions or conditions qualify for payments, which producers will be eligible to receive those payments, and how large payments will be. The level of environmental gain actually delivered by the program can vary widely depending on how these questions are answered. Our focus here is on the "what action?" decision. The actions that trigger payments could be either management practices and technologies or the level of environmental performance. For example, conservation programs could provide payments to farmers who adopt a conservation tillage practice or they could pay, per ton, for reductions in soil erosion.

While conservation programs may have multiple objectives, economic theory (and common sense) suggests that the most efficient way to achieve an environmental objective would be to focus directly on the environmental factors (e.g., the tons of soil lost) the program is supposed to address. That can be hard to implement, though, so conservation policy traditionally focused on practices (e.g., the tillage method farmers use) and technologies. The 2002 Conservation Security Program is the first attempt to pay for higher levels of environmental performance. For example, higher estimated levels of soil quality can trigger a larger payment. Of course, the information and modeling costs to implement performance-based programs may be significant. Better agri-environmental process models, and the geographic data they rely on, will help reduce these cost of implementing performance-based programs, and may herald a new era of such programs.

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Voluntary conservation payment programs need to specify who is eligible to receive payments, how much can be received, for what actions, and the means by which applicants are selected. The achievement of program goals in a cost-effective manner hinges on the choices policymakers and program managers make when answering these questions. **This Economic Brief is one in a set of five** exploring specific design options these decisionmakers face:

(1) income support versus environmental objectives,

(2) alternative ways to target programs,

(3) the use of bidding in determining payment levels,

(4) land retirement and conservation on working lands, and

(5) payments for conservation practices versus the level of environmental performance.

Available at www.ers.usda.gov/publications/eb1, . . ./eb2, . . ./eb3, . . ./eb4, and . . ./eb5

Performance-Based Programs Can Reap More Benefits, But Are More Complex to Implement

Ideally, a measurement tool would exist that links conservation program incentives to the environmental indicator of interest. However, agricultural emissions from individual farms generally cannot be monitored at a reasonable cost. The path from policy incentives to environmental outcomes is complex and multi-stage. Program incentives can motivate changes in farmers' behavior, which may beget field-level changes (say, in nutrient runoff or habitat preservation), which have the potential to improve aggregate environmental indicators (fig.1). Even then, it is uncertain which indicator—water quality or wildlife populations, for instance—society values most.

For most agri-environmental issues, the many links from program design to societal welfare are unknown and expensive to monitor. In some cases, physical process models like the Universal Soil Loss Equation and the Wind Erosion Equation can estimate the effectiveness of some practices in changing field-level emissions. But applying such models farm by farm or field by field is expensive. Even where good estimates of edge-of-field soil losses are available, links between those losses and environmental quality (e.g., sediment loads or concentrations in rivers) are tentative. To date, use of wind and water soil erosion equations, as in USDA's Conservation Reserve Program and Environmental Quality Incentives Program, has been limited to factors that rank program participants, not as a basis for determining payment levels.

The 2002 Conservation Security Program is the first to take limited forays into increased payments for higher levels of estimated soil quality, using a soil condition index to evaluate performance. Other models gaining acceptance in conservation planning and program implementation include a pesticide environmental risk screening tool and new approaches to assessing rangeland and wildlife habitat. Physical process models for field-level use are not yet available for many agricultural emissions. Those models that do exist for physical processes like nutrient runoff are more complex and require extensive user training and data for successful implementation.

The increased information and modeling costs to implement performance-based programs are not included in our analysis, because data are scarce. However, these costs may significantly increase a program's cost, thus reducing its net economic benefits. Advances in developing and automating agri-environmental process models, and expansions in the spatially linked data they rely on, will reduce the costs associated with their use and could facilitate the use of performance-based incentives.

Figure 1

Farmers' management practices affect ambient environmental quality. . .

Inputs		Runoff		Water quality		Damages
nitrogen fertilizer use	→	nitrogen runoff from fields	→	nitrogen concentrations in stream	→	changing fish populations affect recreational benefits

Source: Smith and Weinberg, *Amber Waves*, September 2004

Tradeoffs Inherent in Rewarding Practices Versus Performance

Both practice-based and performance-based policies aim to motivate producers to improve (or maintain) their environmental performance. However, because practice-based policies are indirectly linked to environmental performance, producers may respond differently than to performance-based incentives. For example, the vast majority of sediment actually reaching the river in a given watershed may come from a handful of fields. Policies aimed at reducing soil erosion on just those fields would be significantly more cost-effective than rewarding practices on all fields or on a set of fields selected by another method.

Because data on program performance are scarce and interactions are complex, we examine just *how much* more cost-effective a performance-based program is by simulating a practice-based program (in which payments are tied to farmers' costs of installing the practice) and a performance-based program. The simulated performance-based program bases payments on an "aggregate environmental index," similar to the Conservation Reserve Program's Environmental Benefits Index. This index is designed to represent the overall environmental impact of various cropping systems across a broad range of environmental outcomes, including the quality of surface water, ground water, soil and air (see methods box).

For any given program budget, a performance-based payment program achieves much greater environmental gain than the practice-based program (fig. 2). With a $1-billion budget, the performance-based program generates more than twice the environmental quality (as measured by environmental index "points") as the practice-based program is estimated to achieve (represented by the horizontal difference between curves in fig. 2). Similarly, the same environmental benefits attained with a $1-billion practice-based program could be had for only $200 million if payments were based on environmental performance (represented by the vertical distance between curves in fig. 2).

Two factors drive these results:

Location, location, location. Just as in real estate, the location of a farm or field can have a large impact on its value in terms of the environment. In some locations, reductions in farmgate emissions of nutrients and sediments may have limited environmental benefits. A farm that is far from a river is likely to have a smaller impact on water quality than a farm adjacent to the river. Similarly, installing a soil-preserving practice on a field with low erosion potential would likely net less environmental benefits than installing the same practice on a highly erodi-

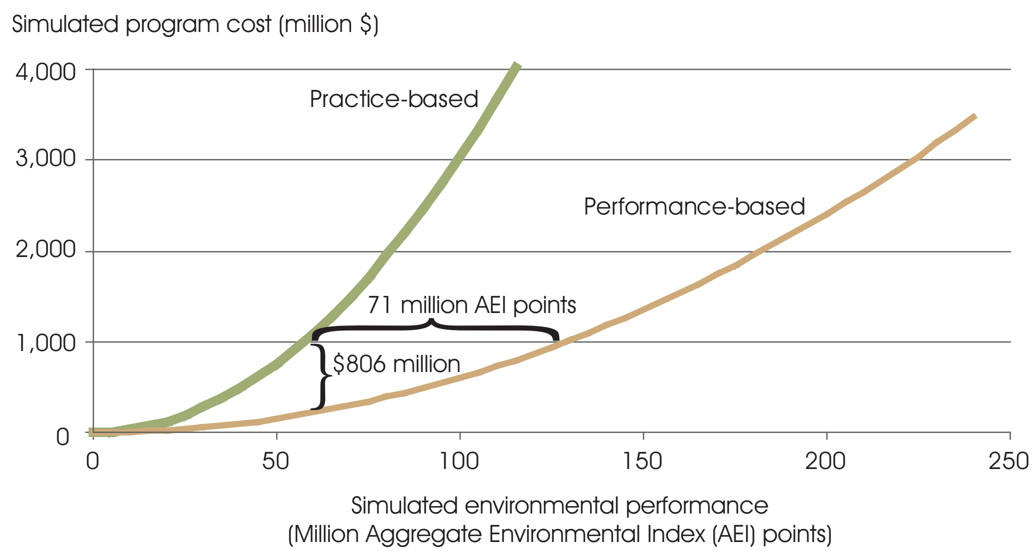
Measuring Agri-Environmental Performance

A variety of methods can be used to determine environmental performance. The results presented here are based on two different indices. For the results in fig. 2 (based on *Flexible Conservation Measures on Working Land*, ERR-5), performance-based payments are based on an aggregate environmental index constructed to represent the overall environmental impact of various cropping systems. The index is a weighted sum of nine agri-environmental outcomes—pesticide, sediment, nitrogen, and phosphorous loadings to surface water, pesticide and nitrogen loadings to ground water, wind erosion, soil carbon emissions, and soil quality (maintenance of soil productivity). The individual indicators are combined to generate an aggregate environmental index score (AEI) specific to each production system and region. For the results in fig. 3 (based on *Agri-Environmental Policy at the Crossroads*, AER-794), payments are based on the potential value of water quality gains due to reduced soil erosion and sedimentation. Payments are highest where the potential for soil erosion reduction is large and the water quality benefits of reducing soil erosion are high.

Figure 2

Environmental performance is more costly if programs pay for practices than if they pay for performance

Program cost and predicted environmental performance for practice- and performance-based scenarios. Difference in program cost for practice- and performance-based scenarios for given environmental quality levels attained with each program.



ble field. A practice-based program that pays out regardless of location or other field characteristics could be funding many practices of marginal environmental benefit.

Producer flexibility will generally reduce the producer's cost of complying with program requirements (i.e., earning a conservation payment). Producers generally have more than one way to achieve an agri-environmental goal such as reducing soil erosion or nutrient runoff. The flexibility of a performance-based program enables producers to unleash their creativity and tailor their environmental stewardship to their own resource and management setting. A "one-size-fits-all" approach that mandates a specific practice or technology is usually more expensive because the least-cost option may be different for each farmer.

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Conservation Programs Can Be Practice- and Performance-Based

Options for achieving some of the benefits of performance-based programs while retaining the relative ease and transparency of practice-based programs are plentiful. None will achieve the same potential environmental gain and cost savings as a "pure" performance-based program. But with careful design, the costs and benefits of practice-based programs can be improved significantly. For example, payments for practices may vary by expected performance levels, e.g., paying more for practices thought to be the most effective, or enrolling just those farmers offering to adopt (the most) practices most likely to generate environmental benefits (see Economic Brief Nos. 2 and 3).

Conservation compliance is an example of a hybrid policy, with both practice-based and performance-based characteristics. It is **performance**-based in that farmers with highly erodible land are required to reduce soil erosion below a tolerance level ("T") as a condition of eligibility for most farm commodity and conservation programs. Farmers can meet this requirement by developing an approved conservation plan describing the collection of conservation **practices** applied together that they will implement. USDA has

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approved more than 1,600 unique conservation systems for use, indicating that farmers are taking advantage of the built-in flexibility. In practice, however, compliance is more like a practice-based program in that the focus of program implementation is on whether or not those practices submitted are in fact adopted (rather than on whether "T" is actually achieved). This is particularly true in areas where the erosion goal ("T") is hard to reach.

Funding Environmental Improvements Rather Than Maintenance Can Generate More Benefits

Policymakers and program decisionmakers are not finished once they determine whether to use practices or performance as the payment trigger. They must also decide whether to base payments on the level (or existence) of a particular practice or environmental achievement, or to base payments on improvements in practices or performance. For practice-based programs, this decision comes down to paying for new practices or for all preferred practices (regardless of when they were adopted).

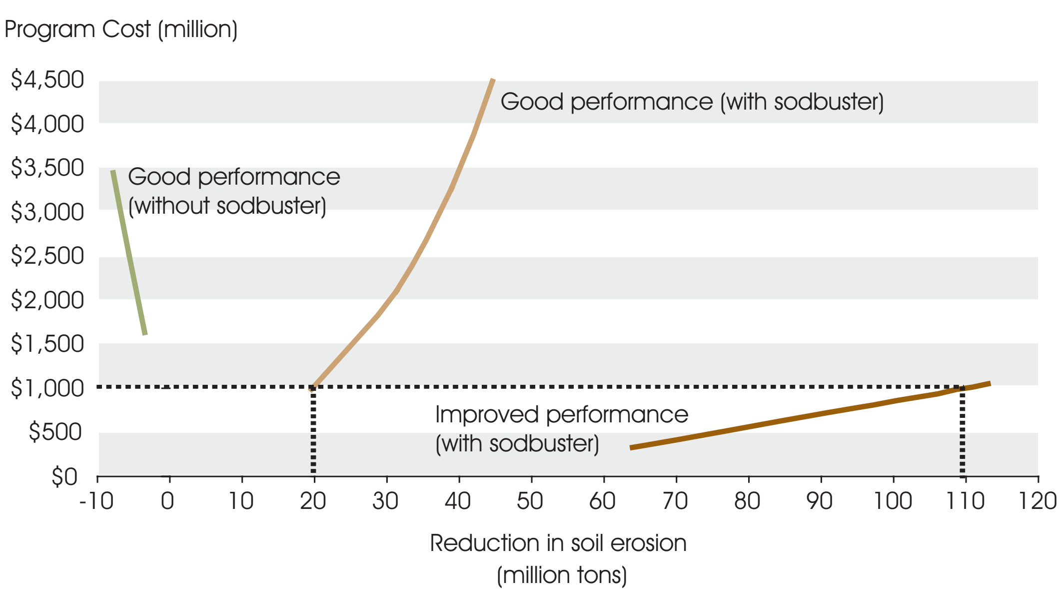
In a "good performance" scenario, all farms that have achieved a relatively low ("good") level of soil erosion (in this case) receive a payment. This contrasts with a program that subsidizes producers only if they reduce erosion ("improve performance") on their fields.

Simulation results suggest that the "improved performance" policy could provide much larger environmental benefits than a "good performance" program for the same level of expenditures (fig. 3). A $1-billion program with payments for improved performance produces over 5 times the reduction in soil erosion (nearly 110 million tons versus 20 million tons) than if payments are provided for good performance. Further, the advantage of the "improved performance" program increases with program size (the distance between the good performance and improved performance curves in figure 3 gets larger as program cost increases).

The wide discrepancy in results is because the "good performance" scenario pays for existing practices as well as new ones. For example, it would make the same payment to a farmer who has been using no-till

Figure 3

Paying for improved performance increases environmental benefits relative to a program that pays for good performance, per dollar spent, though soil erosion could increase without a sodbuster-type policy limiting conservation payments to land already in production



for the past 10 years as to a farmer adopting it for the first time. Thus, some payments would go to reward "good actors"—producers who are already using potentially environmentally beneficial practices such as conservation tillage or have already achieved low erosion rates on cropland acres—for past performance and may help ensure that past gains are retained, but will not necessarily contribute to an increase in environmental performance. The stewardship component of the Conservation Security Program created by the 2002 Farm Security and Rural Investment Act is an example of a "good actor" feature.

However, payments based on improved practices or performance require USDA to gather a great deal of information, plan extensively, and enforce diligently. A farm-level or field-specific baseline of past production management and conservation practices would be needed to assess the extent to which a change has occurred. Depending on the environmental improvement or type of practice targeted, improvement-based programs could require extensive data on past land use, crop rotations, input use (e.g., fertilizer application rates), and cropping practices (e.g., tillage systems). Such baseline information is not widely available and could be costly to collect. Collecting baseline information after enactment of an agri-environmental payment program could invite gaming: producers could temporarily abandon some environmentally favorable practices to obtain a more favorable baseline. These activities may require considerable resources at a time when funding for conservation planning and technical assistance is limited.

Plus, payments for improvements only may be viewed as inequitable by some producers. "Good actors" may argue that past gains entitle them to the same payments received by producers who improved environmental performance only in response to agri-environmental payments.

Careful Program Design Can Help Avoid Unintended Consequences

By changing the relative costs of farming with conservation practices, conservation payment programs could unintentionally cause farmers to take actions that may not be in the best interest of the environment. For example, farmers might respond to conservation payments by bringing more cropland into production.

Figure 3 simulates erosion reduction and program payments for the "good performance" scenario with and without a penalty for expanding cropland onto highly erodible land (similar to the "sodbuster" provision in the 1985 Food Security Act, which stated that producers who bring highly erodible land into crop production must apply an approved soil conservation system or risk loss of farm program payments). Without the sodbuster restriction, aggregate erosion reduction is negative—erosion actually increases—due to cropland expansion. Even if good environmental practices are used on additional cropland and per-acre emissions are low, soil erosion will almost surely increase relative to when that land was not cropped. As program size increases, this effect gets larger and could severely undercut aggregate environmental gains.

Cropland expansion may be encouraged when (1) payments are large enough to make production on marginal cropland profitable after installing subsidized conservation practices, (2) overall environmental improvement is not required to be eligible for a conservation payment, and (3) previously uncropped land is eligible for payments. Ensuring, in program design, that at least one of the three conditions does not hold can help avoid such unintended consequences.

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This brief is drawn from . . .

Cattaneo, A., R. Claassen, R. Johansson, and M. Weinberg. 2005. *Flexible Conservation Measures on Working Land: What Challenges Lie Ahead?* U.S. Dept. Agr., Econ. Res. Serv., ERR-5, June.

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