Resources & Environment

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# Environmental Payments To Farmers: Issues of Program Design

Interest is growing in broadening the array of government programs that would help to improve the environmental performance of agriculture and at the same time provide some income support to agricultural producers. Associated with agricultural production are beneficial environmental impacts—e.g., rural landscape amenities, habitat for plants and wildlife, and cleaner air from emissions-absorbing land sinks—as well as adverse impacts—e.g., soil erosion, runoff from nutrients and pesticides, and loss of wetlands and other natural habitats. In a competitive economy, agricultural producers have few, if any, financial incentives to provide *environmental services*—i.e., maintain beneficial impacts or mitigate adverse environmental impacts—without government involvement. Government "agri-environmental" payments programs pay producers to provide environmental services.

Existing agri-environmental payments programs include the Conservation Reserve Program (CRP), the Wetlands Reserve Program (WRP), and the Environmental Quality Incentives Program (EQIP). Efforts undertaken under these programs have significantly reduced erosion of farmland, restored over 900,000 acres of wetland previously converted to crop production, and generally improved wildlife habitat on agricultural land. Nevertheless, agriculture continues to confront environmental problems, particularly water pollution from runoff that carries nitrogen and phosphorous from fertilizer and animal waste. Government efforts to help reach environmental goals as well as to supplement farm income could include a program of payments to farmers who are "certified" as environmentally sound or could resemble a recently proposed "conservation security program" to provide payments to farmers based on their adoption of designated conservation practices.

This article explores some common but complex features of agri-environmental relationships that will affect the design of agri-environmental payments programs. While not critiquing current or proposed policies, the discussion highlights some program design features necessary for an agri-environmental payments program that is environmentally cost-effective.

### *Agri-Environmental Problems Are Complex*

Many of the ways that agriculture affects environmental quality appear quite obvious. For example, farmers may use nutrient management practices to help prevent water pollution, which in turn enhances opportunities for water-based recreation. However, relationships among management practices on specific farms, effects on environmental services, and benefits derived from these services are often complex and not completely understood. The interactions, along with a number of characteristics common to many agri-environmental problems, complicate the design of any potential agri-environmental payments program. These characteristics include the following:

*Multiple contributors to problems*. A large share of agri-environmental problems are the result of the accumulation of small effects from a large number of farms. Under most circumstances, reducing sediment flows from a single farm or restoring a single area as wetland has no noticeable impact on water quality or on populations of wetland-dependent wildlife. However, the collective impact of many actors who reduce sediment flows or restore wetlands may result in significant improvements in water quality or wildlife populations.

*Difficulty in observing and/or measuring impacts*. A particular contribution to agri-environmental impacts is often difficult to observe and measure, and the more numerous the contributors to the problem, the more difficult monitoring becomes. For example, erosion and nutrient runoff do not originate at any fixed point, unlike emissions from industrial sources of pollution. Instead, these so-called "nonpoint" emissions occur diffusely over broad land areas, and sediment and nutrients leave multiple fields in many places, making accurate monitoring too costly under current technologies.

Even where certain positive environmental outcomes might be easy to observe, the full flow of environmental services often cannot be directly measured. For example, it may be easy to observe the creation of suitable habitat for migrating waterfowl, measure the size of the area, and identify improvements in overall habitat quality. However, it may be difficult to quantify the impact of this new and improved habitat on bird populations.

*Heterogeneity in underlying conditions*. Agriculture is extremely diverse. Crops and production management practices vary widely among regions. Management skills, preferences, and attitudes regarding environmental protection, as well as the costs of protection, vary widely among agricultural producers. And environmental impacts of agricultural production depend on the mix of fixed, site-specific characteristics such as climate, soil type, topography, and location in relation to affected resources (e.g., rivers and lakes). This diversity in production conditions implies that one-size-fits-all agri-environmental policies are unlikely to be environmentally cost-effective nationwide. A specific conservation practice may be a good fit in one farming operation and provide significant environmental services, but in another setting may be either inappropriate or ineffective.

*Unpredictability of natural events*. Many agri-environmental problems are subject to significant year-to-year variation in weather conditions as well as variation across farms and regions. For example, erosion and polluted runoff (including transport to water or other resources) can vary greatly due to weather-related events and other environmental conditions outside producers' control. Encouraging practices that reduce the *average* level of erosion or polluted runoff may not prevent excessive erosion or runoff during particularly large or intense weather "events," although such events may have the greatest overall impact on the environment. If payments are made contingent on actual positive environmental impacts (to the extent that these can be measured), producers could see fluctuations in their payments due to unpredictable factors outside their control.

## *Zeroing in on Cost-Effectiveness*

A cost-effective agri-environmental payments program aims to achieve the greatest possible environmental benefit for the level of resources committed to the program. Such a program would:

- assign greater priority to providing agri-environmental services that are more highly valued and/or that can be provided at lower cost;
- target or direct program payments to producers and activities to reflect these priorities;
- incorporate sufficient flexibility to allow producers, when possible, to select the lowest cost method of producing environmental services.; and
- consider the feasibility and cost of ensuring that promised activities to improve environmental performance are effectively implemented.

Net benefits stemming from an agri-environmental payments program will be larger if higher priority is assigned to agri-environmental services that are more valued and/or less costly. Priorities could be assigned taking into consideration a spread of agri-environmental issues and goals (e.g., cutting nutrient loads to a coastal zone vs. enhancing wildlife habitat) across various regions of the country (e.g., Northern Crescent vs. the Heartland). Priorities could also take into consideration whether providing environmental services adds value to agricultural activities or mitigates damages. Unfortunately, a measure of benefits from "non-market" items (e.g., enhanced recreation) is necessary for prioritization but often difficult to value.

Even with limited information on the value of benefits, it may still be possible to prioritize environmental services. The Environmental Benefits Index (EBI)—which USDA uses to determine acreage to accept in the CRP—is a good example of environmental targeting that makes the most of available information (*AO* June-July 1999). USDA estimates an EBI environmental score for proposed CRP contracts based on weighted values for environmental services likely to be derived, and ranks contracts by the EBI score (sum of the environmental score and the proposed cost, i.e., the landowner's bid).

Although the EBI is a less-than-comprehensive benefit measure—it is limited to six environmental factors plus rental cost—a study by USDA's Economic Research Service (ERS) indicates that use of the EBI has doubled CRP-related benefits from freshwater-based recreation and wildlife viewing. The study also shows that the EBI can be improved. For example, ERS research suggests that wildlife recreation benefits are generally greater than benefits from enhanced freshwater-based recreation, but they receive equal weight in the current EBI. Also, the EBI could more fully reflect the likelihood of higher value of benefits when environmental improvements are located near populated areas, where more people have relatively easy access to recreational amenities.

Once priorities for environmental services have been established, the focus turns to administration of payments to farmers providing the services. Program requirements will generally be realistic only if payments are based on farming practices or environmental outcomes that are controllable by the producer and are observable. Environmental cost-effectiveness is maximized when 1) subsidized actions are linked as directly as possible to provision of high-priority environmental services, and 2) producers who take these actions are given greater incentive to participate or higher priority in the programs' selection process. In other words, if payments are targeted, program goals may be achieved with relatively lower outlays.

Linking changes in specific practices on specific farms to the provision of environmental services is crucial to designing an environmentally cost-effective agri-environmental payments program. These links can sometimes be described using *physi-*

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* Environmental Regulations and Location of Animal Production

*cal process models* that estimate the effects of management practice changes on soil erosion or nutrient runoff. Other models can sometimes be used to trace the flow of sediment, nutrients, or pesticides downstream or to ground water.

A major barrier to broad use of physical process models to link practices to performance is the level of information and technical assistance necessary for implementation. Some physical process models, such as the Universal Soil Loss Equation (USLE) and Wind Erosion Equation (WEE) are comparatively simple, requiring a total of six variables (e.g., soil characteristics, topography, climate, and farming practices) to estimate average annual erosion. In contrast, physical process models of nutrient and pesticide runoff are far more complex, often requiring dozens of variables and substantial training for successful use.

In prioritizing environmental services and targeting agricultural practices, policymakers could also consider patterns in the occurrence of natural events. For example, since nutrient loads (quantity of waterborne nutrients such as nitrogen and phosphorus) to a body of water often vary with weather conditions, degree of variability instead of average load may be key to assessing recreation potential of a water resource and to targeting desired practices for prevention of excess loadings. Such a situation might occur if infrequent but severe flooding increased estuarine nutrient loadings and caused massive fish kills, which could ruin recreation and commercial fishing for several seasons. In such circumstances, assigning greater priority to practices that tend to mitigate runoff due to large storm events may be more environmentally cost-effective than encouraging practices that reduce average loads over a period of years.

Another element for identifying the size of producer actions or practices eligible for an agri-environmental payment is determination of an appropriate "baseline." Baselines represent the level of practice adoption, input use, or other indicators of environmental performance from which changes can be measured for the purpose of calculating payments. Baselines may be farm-specific or may be specific only to geographic areas and/or specific soil types, because information on farm-specific crop mixes, management and production practices, and input use is often limited. For example, a soil erosion baseline could be defined by the average annual erosion rate for a production system involving a predominant crop rotation and conventional tillage practices. If producers adopt or have previously adopted a less erosive crop rotation or a reduced tillage practice, they could receive payments proportional to the erosion reduction achieved (as measured by the USLE).

Establishing appropriate baseline levels may help avoid unintended negative consequences. In the erosion example, if baselines are set too high, an agri-environmental payments program may serve to maintain or even to expand production on marginal farmland to take advantage of agri-environmental payments, perhaps rewarding inefficiency and limiting the program's environmental effectiveness. Limiting eligibility to land that has previously been in production may be an effective restriction, and enforcing swampbuster and sodbuster regulations—which deny government program benefits to farmers who convert land designated as wetlands to crop production, or who fail to implement approved soil conservation systems on highly erodible land—may provide a strong disincentive to convert environmentally sensitive land to crop production.

Once policymakers have determined standards for farms that should be eligible for payments and have delineated the associated program requirements, they must decide the size of the payments. Producers will participate only if payments cover the full cost of program participation, or if the program generates some private benefit beyond program payments (e.g., if controlling soil erosion also enhances soil productivity). Environmental cost-effectiveness may be increased by providing larger payments to producers and actions most directly associated with environmental priorities of the program, so long as payments are commensurate with ensuing benefits. Larger payments could serve as an inducement to farmers whose actions can produce greater environmental services, particularly those who can produce those services at a relatively low cost.

A second way to prioritize expenditure of program funds is to solicit bids from producers for their application of management practices. In the CRP, for example, producer bids for rental payments are factored in with EBI environmental scores to determine which contracts will be accepted. Producers who exhibit high environmental scores relative to costs can proffer bids that are more likely to be accepted, highlighting the complementarity of potential environmental services and cost of producing those services.

Suppose, for example, that reducing nutrient loads to coastal estuaries is a priority. If actions taken to reduce nutrient loads to coastal estuaries are twice as effective on farm A as on farm B, farm A would be eligible for a larger payment because its potential contribution to reducing nutrient loads is larger. However, the environmental cost-effectiveness of subsidizing a specific action taken by a given producer also depends on the cost of taking the action. Using the same example, if the cost of actions to reduce nutrient loads are much lower on farm B than on farm A, farm B may actually be able to reduce estuarine nutrient loadings more cost-effectively.

### *Customized Plans For Common Goals*

Once the link is established between environmental services, farms, and management practices, there is often more than one farm and resource management strategy a producer could use to achieve a conservation or environmental objective. A flexible, environmentally cost-effective agri-environmental payments program would give producers an opportunity to design conservation plans that minimize their cost of meeting environmental objectives.

For example, EQIP—which provides technical and financial assistance for improved irrigation, cropping and grazing systems, wildlife habitat, sediment control, and manure, nutrient, and pest management—is a flexible program that allows potential participants a great deal of latitude in selecting practices tailored to their own farming operation. Producers who enter into 5- to 10-year contracts implementing EQIP conservation plans receive technical assistance, education, cost-sharing, and incentive payments. In contrast, the CRP requires a single fixed action (retire land for a period of 10 years) in return for annual rental payments, and some producers may be reluctant to relinquish control of land use for such a long period of time. However, since most agricultural activity ceases on land enrolled in the CRP, the program is relatively easy to enforce and therefore likely to produce expected environmental improvements.

Another relatively flexible agri-environmental payments mechanism would be a per-unit subsidy for increases in environmental services or actions likely to improve environmental services. For example, a fixed payment could be made for each pound of reduced fertilizer inputs. Producers would be free to vary fertilizer use, weighing tradeoffs between the amount of the agri-environmental payment and the net cost of changing fertilizer use, which will fluctuate with economic conditions.

When links between agricultural practices and environmental services are strong, conservation plans can be designed with performance objectives in mind, allowing producers to devise individualized farm plans to meet conservation and environmental objectives. For example, USDA's Conservation Compliance Program requires producers who farm highly erodible land to implement soil conservation plans in order to remain eligible for farm program payments. USDA determines whether proposed plans meet erosion reduction requirements by using the Universal Soil Loss Equation and/or the Wind Erosion Equation.

A 1997 USDA review of conservation compliance plans found 1,674 different sets of practices in approved conservation plans. Plans involving conservation cropping sequences, conservation tillage, crop residue use, or some combination of these three practices were applied on 54 percent of land subject to Conservation Compliance Program regulations. Nonetheless, individual plans vary widely among regions, based on cropping patterns, production systems, climate, and soils, demonstrating that producers do take advantage of flexibility in national programs.

### *Effects Beyond the Environment*

Agri-environmental payments is a policy instrument that could be used more extensively to reduce environmental damages and increase environmental benefits associated with agricultural production. But an agri-environmental payments program may also affect commodity markets and farm income. Farm income could be affected through 1) payment size and distribution; 2) changes in direct farm costs resulting from changes in production practices and enterprise mix, cropping patterns, or crop yields; and 3) swings in commodity market prices resulting from shifts in production. An extensive agri-environmental payments program could also affect commodity trade flows (*AO* May 2000). If agri-environmental payments from programs designed to bolster farm income and produce environmental amenities are large, they could become a foreign trade issue because of World Trade Organization rules on trade-distorting domestic policies. Research is under way at ERS that will help to determine whether and how a more extensive program of agri-environmental payments could affect commodity markets and trade.

In a sense, an agri-environmental payments program provides a market for environmental services that are produced along with agricultural commodities. Those who can produce environmental services at a low cost can reap the benefits of the "agri-environmental" market by participating in the program. Nonparticipating producers may also feel some effects from agri-environmental payments programs if shifts from production of commodities to production of environmental services cause movement in commodity prices. AO

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**July Releases—USDA's Agricultural Statistics Board**

The following reports are issued electronically at 3 p.m. (ET) unless otherwise indicated.

**July**

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| 3 | *Dairy Products* |
| | *Crop Progress (4 pm)* |
| 5 | *Weather - Crop Summary* |
| 6 | *Broiler Hatchery* |
| | *Egg Products* |
| 7 | *Dairy Products Prices (8:30 am)* |
| | *Agricultural Cash Rents* |
| | *Noncitrus Fruits & Nuts - Ann.* |
| | *Poultry Slaughter* |
| 10 | *Vegetables* |
| | *Crop Progress (4 pm)* |
| 11 | *Weather - Crop Summary* |
| 12 | *Crop Production (8:30 am)* |
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| 13 | *Turkey Hatchery* |
| 14 | *Dairy Products Prices (8:30 am)* |
| 17 | *Milk Production* |
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| 21 | *Dairy Products Prices (8:30 am)* |
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| | *Chickens & Eggs* |
| | *Crop Progress (4 pm)* |
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