

# **Balancing the Multiple Objectives of Conservation Programs**

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## **Introduction**

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Historically, the primary function of agriculture has been the production of food and fiber. Over the last several decades, however, the multidimensional aspects of agriculture have taken on a progressively more important role. Structural changes in the economy, technological improvements in agriculture, and urbanization have expanded society's perception of agriculture as a provider of a variety of outputs, especially in industrialized countries. In particular, public awareness of the positive and negative byproducts of agricultural production is increasing.

In unregulated markets, agricultural producers often bear few or none of the costs associated with negative byproducts, and they reap few benefits of the positive byproducts, of agricultural production—rather, these costs and benefits accrue to society as a whole. Due to these “externalities,” governments may seek to influence agricultural producers' incentives and choices in ways that limit the negative, and increase the positive, impacts. These efforts can be narrowly focused on a single objective, or they can be simultaneously concerned with multiple objectives.

### **Addressing Multiple Objectives: Multiple Programs or One Multi-Objective Program?**

Government intervention in agriculture can take numerous forms, including regulatory measures (such as standards, bans, and restrictions on input use) and incentive-based measures (such as voluntary conservation programs and subsidies). In situations where producers create private goods in combination with externalities, economists' standard policy recommendation is to let market forces freely determine the level of production, consumption, and trade of the private goods, while at the same time address any positive or negative externalities through targeted policy measures.

Standard economic policy theory implies an optimal strategy would address each externality through a separate policy instrument (Tinbergen, 1952). However, addressing each externality through a separate policy instrument is optimal only under certain conditions: program implementation/administrative costs must be negligible, and policy objectives must be independent of each other. But, in fact:

- Program implementation costs are high. By some estimates, administrative costs for conservation programs in the United States and Europe range from about 5 to nearly 50 percent of total program costs—about 20 times higher than administrative costs for traditional price and income support programs (Falconer et al., 2001; Falconer and Whitby, 1999; McCann and Easter, 2000; Vatn, 2002; Leathers, 1991 ).
- Linkages can exist among the externalities targeted by a policy. For example, phosphorus travels off-farm through binding with eroded soil particles, contributing to a “complementary” relationship between soil erosion and phosphorus runoff (USDA-NRCS, 1997). Alternatively, the water and air quality externalities associated with animal waste problems may be considered “substitutes,” when reducing runoff to improve water quality leads to increased emissions that worsen air quality. In such cases, achieving a single policy objective independently may be difficult or impossible (see box, “Linkages Between Agri-Environmental Externalities”).
- Externalities that do not initially appear to be strongly linked (as complements or substitutes) may become so, once a program’s eligibility criteria constrain the universe of land that qualifies for program participation. For example, a program might target highly erodible lands, and phosphorus runoff and soil erosion externalities may be more closely associated on these lands than on other land types.

For these reasons, separate programs aimed at altering producer choices to reduce each of the negative externalities associated with agricultural production may not be optimal (see box, “Potential Inefficiencies From a Multiple Program Approach: An Illustrative Example”). Indeed, many conservation programs today are designed to achieve multiple objectives.

## **Prioritizing Objectives in a Multi-Objective, Voluntary Program**

The need for prioritizing program objectives often arises in the context of voluntary conservation programs. Rarely are budgets (or acreage targets, if a fixed amount of land is sought for enrollment) large enough to enroll all producers who offer to apply in any particular year. Prioritizing can encourage efficiency, because doing so allows program managers to first enroll those potential program participants offering to provide the most value to society.

In theory, program managers can design an efficient multi-objective program when they have and use information on society’s values for the positive and negative externalities the program seeks to address. In practice, estimating and comparing the relative value of offers, where each offer addresses a diverse mixture of environmental concerns, is no easy task. Perhaps the most difficult aspect of this is that information on the relative importance society places on different environmental concerns is often not available. This hampers a program manager’s ability to determine the priority to place on each concern.

## Linkages Between Agri-Environmental Externalities

Many factors can affect the outcomes of conservation policies, including relationships that exist among the environmental resources of concern. Analogous to how economists describe commodities or factors of production as “complements” when they tend to be used together, or “substitutes” when they tend to be used in place of the other, resources can be thought of as “complements” or “substitutes.” Resources can be thought of as complements when an improvement (decline) in one environmental resource results in an improvement (decline) in the other. A resource that acts as substitute has the opposite or no effect on other resources when improvements (declines) occur to it.

These linkages between environmental resources can arise from the following:

- *Intrinsic relationships between the externalities.* For example, phosphorus runoff and soil erosion are intrinsically related, because by its nature phosphorus attaches to eroded soil particles to travel off-farm.
- *Land use allocations.* How producers allocate a fixed amount of land can give rise to complementary and substitutability relationships (Boisvert, 2001). For example, some crop rotations generate complementary reductions in erosion and pesticide runoff but the substitution effect is more nitrogen leaching (Mitchell et al., 1998; USDA-NRCS, 1997).
- *Choices made in the production process.* Complementary relationships can arise when producers choose inputs that jointly produce a bundle of outputs. For example, the labor required to implement a no-till practice that produces both erosion reduction and wildlife benefits is a nonallocable input.

When these linkages exist, the methods used to address one environmental concern can influence other environmental concerns. Accounting for these linked externalities is possible in a multi-objective, but not in a single objective, program approach.

In some cases, program managers can prioritize different environmental concerns based on monetary values that are derived from measures of the net benefits reaped by society when each of the different environmental concerns is alleviated. Alternatively, program managers can use stakeholder input to establish the relative importance of different environmental concerns. However, net benefits are often not available, and obtaining stakeholder input and engaging in negotiations can be very costly and time consuming. This means policymakers or program managers are often faced with prioritizing based on their perceptions of stakeholder preferences and societal goals. Nevertheless, the prioritization can be guided by monetary estimates for benefits when they exist, even if incomplete.

## Potential Inefficiencies From a Multiple Program Approach: An Illustrative Example

To illustrate how high program implementation/administrative costs (economists refer to these as “transaction costs”) and interrelationships between policy objectives can affect the efficiency of implementing multiple programs, consider a case where program managers have the option to either set up separate conservation programs aimed at reducing soil erosion, reducing nitrogen runoff, and increasing wildlife habitat, or introduce one comprehensive program considering all three of these environmental concerns at the same time.

Some features would be common to both approaches: producers voluntarily submit offers to provide environmental services on agricultural land, they agree to implement certain practices or retire certain land from production, and those accepted into the program are paid their offer amount.

The multiple program approach would likely have greater transaction costs than a single multi-objective program, given the larger number of separate contracts to be stipulated. It could also create inefficiencies due to the interrelationships between environmental concerns. For example, a producer may offer to install vegetation cover on a parcel close to a stream, which would provide multiple benefits (such as erosion control, wildlife habitat benefits, and aesthetic benefits). This offer may be rejected by each of the separate programs because vegetation cover does not provide enough benefits in any single category—even though it would be economically efficient to implement because it provides more aggregate benefits than any other offer/practice combination.

Policymakers or program managers then use these priorities to establish a set of “weights” that is combined with physical measures of each environmental concern to construct an index. This index can be used to assign a single summary score to each program applicant, which summarizes how well each application meets the full set of objectives. The resulting scores are used to rank applications, with higher values indicating which applicants to enroll first.

The weights program managers ultimately use in conservation program indices can act as levers to induce changes in program outcomes. As weights change, index scores on existing offers will change, leading to a change in the ranking and mix of applicants that are enrolled. Furthermore, the incentive effects of weight changes can change the set of lands offered for enrollment: producers who previously offered to enroll land in a program might not do so when faced with a new set of weights, if they perceive the change lowers the likelihood their enrollment offer will be accepted (or that the change lowers the net returns from participating). Similarly, new producers may opt to participate if weight changes induce more favorable perceptions of their enrollment offer being accepted.

Program managers cannot control some factors that affect program outcomes—such as the extent to which environmental concerns are easy for producers to address simultaneously, or the extent to which farm household

characteristics (such as a producer's age) might affect a producer's decision to offer land for program enrollment. Questions arise, then, regarding the sensitivity of a program's outcomes to a program manager's choice of weights. Understanding the sensitivity of program outcomes to weights may be particularly important given that the "correct" weights are rarely determined precisely in the first place. For example, new information may suggest that existing program outcomes do not reflect the relative values society places on the various objectives (or that relative values have changed). Program managers and policymakers could benefit from understanding how outcomes might vary if the weights are changed. To date, few studies have addressed this issue.

Prior research has focused on clarifying what *types* of conservation programs are used, given agriculture's multiple outputs, and recognizing the risk of conflict between such programs and further agricultural trade liberalization (OECD, 2003; Bohman et al., 1999). This report focuses on how the *design* of conservation programs affects economic and environmental outcomes.

With these considerations in mind, this report asks the following questions:

- How do existing conservation programs trade off environmental concerns?
- How sensitive are environmental outcomes and program costs to the choice of weights in a conservation program index? Does the sensitivity vary depending on the number of acres enrolled or on the size of changes in the weights?
- For which environmental concerns would program managers benefit the most from having better information on nonmarket values?