Exploring Methods of Selecting Cropland for Conservation

In the operation of conservation and environmental programs, environmental targeting is a practice that has been increasingly used to improve program performance. Environmental targeting directs program resources to lands where the greatest environmental benefit will be generated for a given expenditure. The objective of environmental targeting is to make the most efficient use of tax dollars allocated to a particular program.

Over half of the $3.2 billion USDA spent on conservation and environmental programs in 1996 was allocated to the Conservation Reserve Program (CRP), which is the largest natural resource conservation program currently operating in the U.S. Since 1991, the CRP has used an environmental targeting mechanism known as the environmental benefits index (EBI) for ranking and selecting offers of cropland to include in the program.

The CRP offers annual rental payments and cost-share assistance to farmers in exchange for the establishment of long-term resource-conserving covers—usually grass or trees—on highly erodible and other environmentally sensitive cropland. Conversion of these lands reduces erosion and improves wildlife habitat, water quality, and air quality. Presently, approximately 30 million acres of cropland are enrolled under 10- or 15-year CRP contracts.

Enrolling millions of acres under the CRP has wide-ranging effects on government expenditures, air quality, water quality, and wildlife habitatat, and can affect agricultural income and food costs. But benefits from the CRP—improvements in environmental quality and the resulting gains in human welfare—depend on the type and location of the land that is enrolled. Until 1990, contracts for most CRP acres were selected based on their potential to reduce soil erosion. But with the environmental benefits index, the ranking of CRP offers can be based on a broader set of environmental criteria (*AO* October 1997).

The EBI scores candidate land parcels based on a wide array of environmental attributes (such as the potential to enhance water quality) as well as program cost factors. In developing the EBI, USDA and other Federal agencies translated the legislative intent of the CRP into factors representing categories of environmental attributes that were considered important, and a point-scoring system was devised to reflect their relative importance. Each of the factors relies on observable characteristics that can be associated with a parcel of land when a farmer's offer is evaluated. At the close of a CRP signup period, candidate parcels with the highest EBI score are given priority for acceptance into the program.

In the 15th signup (March 1997), the scoring system was as follows:

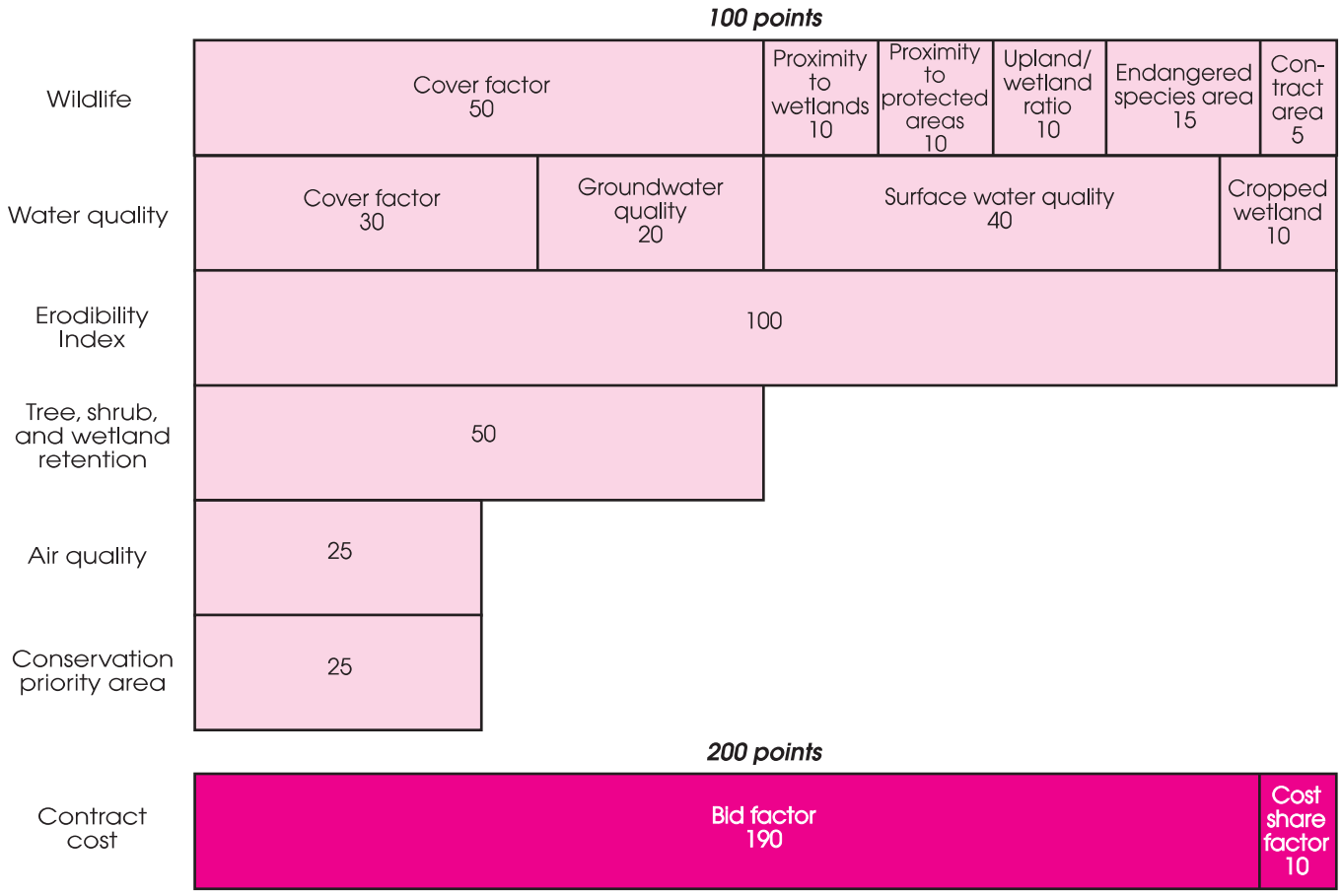
- three factors—wildlife habitat, water quality, and erodibility—were given equal weights of up to 100 points each;
- another factor, the likelihood of retaining environmental benefits of certain practices (such as tree cover) after contracts expire, was given a weight of up to 50 points; and
- two factors—air quality and conservation priority areas—were given weights of up to 25 points each.

A seventh criterion, contract cost, is also considered. While the weight may change from signup to signup, it was weighted at 200 points in the 15th signup.

The EBI is a dynamic process, and its factors and relative weights have been periodically adjusted and improved based on evolving priorities and any perceived deficiencies. The construction of the EBI presently relies on the judgments of natural resource experts and program managers. USDA believes this is the best approach currently available for developing a CRP ranking method because comprehensive and consistent monetary benefit estimates needed for targeting land on a parcel-by-parcel basis do not exist. If disaggregated monetized benefit estimates could be developed to reflect social values for environmental improvement, these estimates could be used to directly select CRP acreage. Such estimates could also be used to compare alternative ranking and selection methods, such as different EBI weighting approaches, informing the process of CRP targeting while recognizing that cost efficiency may not be the only goal in enrolling cropland.

USDA's Economic Research Service is taking some promising steps toward developing a method that could eventually assist in the selection of CRP enrollment,

EBI Scoring Criteria for CRP Cropland Enrollment in the Exploratory Analysis*



* Based on 15th-signup criteria.

using estimates of the monetary value of environmental benefits associated with different land parcels. Using economic valuation techniques, and data on recreation, ERS researchers have demonstrated that it is possible to derive estimates of disaggregated recreational use values to measure and reflect social preferences (essentially, the public's willingness to pay for a particular environmental impact). Such monetized value estimates could be considered for providing additional or alternative input for targeting of CRP acreage, and might also assist targeting efforts in other USDA conservation and environmental programs.

Selecting Land for Conservation

Conceptually, using economic valuation techniques to target land for enrollment is simple. The potential benefits of land enrollment would be measured in monetary terms. Given a complete set of benefits and retirement costs for each land parcel, the parcels would be selected for enrollment on the basis of which ones provide the greatest net benefits. Several alternative EBI scoring systems could be constructed to generate hypothetical CRP distributions, and the scoring system yielding the greatest benefits could be adopted.

Presently, the complete set of benefits needed for such an evaluation has not been determined. For example, the CRP affects a number of "use values" (values people derive from using the resource) for such elements as surface- and ground-water quality, air quality, outdoor recreation, and the maintenance of public works. In some cases, avoidance costs—such as the cost of using bottled drinking water due to impaired water quality, and the cost of dredging canals and rivers as a result of erosion—have been used to estimate some of the benefits of environmental programs in the past.

In other cases, such as recreation, the cost-avoidance approach is not applicable. Determining the recreation benefits associated with improvements in the environment involves nonmarket valuation models, which allow the dollar value of these benefits to be estimated based on observed behavior—e.g., money spent by users of a lake for recreation. In any case, benefit estimates associated with small, localized land areas are required in order to effectively target lands for retirement. This requires models based on individual human preferences.

A number of "non-use" values are also affected by the CRP, such as the value people place on knowing that wildlife

Comparing Recreation Benefits: Baseline vs. Hypothetical CRP Distribution

Evaluating a potential environmental benefits index would involve generating a hypothetical CRP cropland distribution based on the criteria of the potential EBI. The benefits of this hypothetical distribution would then be compared with the benefits attributed to the baseline CRP distribution.

In this example, the benefits of CRP land retirement to the use value of recreational activities are measured in terms of *consumer surplus* in $ million/year attributed to the CRP baseline distribution in 1992, and to the hypothetical CRP distribution using 15th-signup EBI criteria. *Consumer surplus* is the amount of money, above and beyond the market price, that a consumer would be willing to pay for a good.

Region	CRP acres	Benefits		
		Water-based recreation	Pheasant hunting	Wildlife viewing
	Million acres	*$ million/year*	*$ million/year*	*$ million/year*
Pacific/Mtn	8.196 → 7.966	1.69 → 4.30	2.70 → 2.51	-34.98** → 3.78
N. Plains	8.884 → 7.999	2.47 → 8.23	26.69 → 22.62	26.75 → 26.95
S. Plains	5.136 → 4.975	1.47 → 3.92	N/A*	62.35 → 115.02
South Eastern	3.678 → 4.290	10.77 → 32.85	N/A*	4.89 → 148.21
North Eastern	8.146 → 8.810	19.94 → 79.66	50.86 → 45.08	288.70 → 341.21
Total	34.040 → 34.040	36.35 → 128.96	80.28 → 70.21	347.71 → 635.17

Numbers on the left side of the arrows represent the distribution/benefits of the baseline. Numbers on the right side represent the distribution/benefits of the hypothetical CRP that was constructed using 15th-signup EBI criteria.
*Limited pheasant hunting occurs in these regions. **The model yields an anomalous negative benefit for wildlife viewing in the Pacific region associated with the distribution of CRP acres. One possible explanation is that the Pacific region contains little CRP land in highly populated States such as California where intensive recreation occurs, and large amounts of CRP land in relatively unpopulated states such as Montana and Wyoming. This results in the appearance that CRP is negatively correlated with recreational activity.

Economic Research Service, USDA

The Pacific/Mountain region contains WA, OR, CA, MT, ID, WY, NV, UT, CO, AZ, NM; the Northern Plains region contains ND, SD, NB, KS; the Southern Plains region contains OK, TX; the South Eastern region contains AR, LA, MS, AL, GA, SC, FL, TN, NC, VA, KT, WV; the North Eastern region contains MN, WI, MI, IA, MO, IL, IN, OH, PA, NY, VT, MD, DE, NJ, RI, CT, MA, NH, ME.

populations are increasing. These values are more difficult to assess and involve the use of contingent valuation methods in which people are asked to designate a monetary value for a particular benefit. Presently, little is known about the magnitude of these types of benefits or even whether they are sensitive to the location of CRP lands.

As a way of demonstrating the potential for environmental targeting based on monetized value estimates, ERS focused on measuring the values the public places on the enhanced recreational benefits that result from the CRP. Recreational activities are often associated with environmental amenities. For example, improved water quality leads to increased enjoyment of water-based recreation activities, and improved species habitat results in better hunting and wildlife-viewing opportunities. Although there are many CRP benefits in addition to outdoor recreation, recreational activities are highly valued. Recreation also provides a useful demonstration of a valuation approach because it involves market-based costs such as travel, so that preferences can be interpreted in dollar-based terms.

New data and improved methodology have permitted a refinement in the estimation of recreation-use values. Although this is only a partial accounting of CRP use-value benefits, the results can demonstrate how economic valuation techniques would work in measuring the benefits of land retirement under the CRP and in developing more refined targeting measures.

Recent ERS analysis has focused on three specific recreational activities that are considered to be heavily influenced by the CRP: water-based recreation, wildlife viewing, and pheasant hunting (the pheasant population has apparently seen significant expansion as a result of habitat benefits resulting from the CRP). The economic models employed in the analysis are based on recreation-use behavior at the individual level, as well as on improved measures of landscape diversity and economic and statistical estimation techniques.

A link is assumed between the physical effects of the CRP and what recreationists value. For example, measures of the distribution of land types in an area (such as the percent of land in transitional wetlands) are used as indicators of the overall abundance of wildlife-viewing opportunities.

The recreation data were gathered from surveys asking the type, frequency, and location of outdoor recreational activities, including the distances respondents were willing to travel to participate in these activities. The distances (presumably involving travel costs) in effect served as a proxy for prices that respondents were willing to pay for recreational benefits of the CRP. Use values for the specific recreational activities were derived from these data.

The models for each of the three recreation activities were estimated from a baseline CRP land distribution observed in 1992, the year much of the survey data were collected. The first step in the analysis was to determine the benefits of the CRP at that time—the contributions added

by CRP vegetative cover to the use value of the three recreational activities.

Once the benefits of a baseline distribution are established, alternative EBI formulations can be constructed and assessed by comparing their benefits to the baseline's. Assessing a potential EBI formulation involves generating a hypothetical CRP distribution based on the criteria of the candidate EBI and then determining the benefits associated with the hypothetical distribution.

To generate a *hypothetical CRP distribution,* ERS used the EBI scoring criteria from the 15th CRP enrollment (1997), as well as information from USDA's 1992 National Resource Inventory data. To make the results consistent with the baseline distribution, total acres were restricted to 34.04 million, with no more than 25 percent of the cropland in any county included in the hypothetical distribution. The results represent estimates of the recreation benefits of a distribution of land different from that of the actual 15th signup. A number of assumptions about what tracts of land would be offered, and especially about the cover types that would be adopted, leads to a different distribution of land than actually occurred in the 15th signup.

In the context of this exploratory analysis, which is limited to recreation benefits and is used to illustrate value-based targeting, observation of both the baseline distribution and the hypothetical redistribution would indicate several things about the recreation benefits of the CRP. Across the three recreation activities considered, wildlife viewing accounts for the largest share of benefits, followed by pheasant hunting and water-based recreation. Across regions, the more densely populated North Eastern region contains a large share of the total benefits, followed by the Plains, the South Eastern, and the Pacific/Mountain regions. (These regions do not coincide with USDA's farm production regions.)

In this exploratory analysis, population density plays an important role in the distribution of recreational benefits within these regions–larger benefits are usually found where CRP lands and population centers intersect, because the values being measured are use values. In general, the closer a recreational resource is to a populated area, the more it will be used, resulting in a higher value. On the other hand, land near population centers typically costs more to enroll than land in less populated areas, affecting the net benefits of enrollment.

In the hypothetical distribution, water-based recreation benefits and wildlife-viewing benefits in all of the regions increase substantially over those in the 1992 baseline distribution. Even in regions that would lose CRP overall, the recreation benefits associated with these two activities increases. This suggests that the EBI of the actual 15th CRP signup more efficiently allocates acreage in terms of the recreation benefits associated with these activities compared with earlier CRP enrollments.

The redistribution shifts CRP acres somewhat from west to east. And since most pheasant hunting occurs in areas that lose CRP under the hypothetical distribution, the pheasant hunting benefits decline slightly from the baseline. However, the model does not take differing types of cover into account, which may affect these results.

If this analysis were being used in an actual application of value-based targeting of CRP land, the results suggest greater value for wildlife than water-based recreation in a future EBI, since the wildlife viewing benefits appear to be greater than the water-based recreation benefits. In addition, these results might indicate a somewhat greater role for human population density in future CRP targeting, since this is an important factor in recreation-use values.

These results are, of course, exploratory and are based solely on use values associated with three recreational activities. Nevertheless, these findings on recreation benefits illustrate how economic valuation techniques could eventually contribute to the development of more refined scoring criteria. Several alternative scoring systems could be constructed and could be used to generate hypothetical CRP distributions, and the scoring system yielding the largest benefits could be adopted for a particular signup.

Extensive work would be required before alternative EBI formulations could be compared and before acreage could be enrolled based on monetized measures of benefits. In addition to the three recreational benefits described in this article, all other benefits affected by the location as well as by the characteristics of CRP land would need to be determined. Among these benefits are:

- *The remaining recreational use values significantly affected by the CRP.* This requires analyzing additional new data on recreation and improving the understanding of ecological processes associated with the CRP, such as changes in animal populations.
- *The impact on public works and industrial operations as sediment loadings are reduced*. Updates to engineering and other physical models can address these issues.
- *The value of improved air quality.* This would require better models of wind erosion, and new estimates of the health and other impacts of airborne sediments.
- *A measure of public willingness to pay for the CRP's improvements in ecosystems,* including the preservation of endangered species, wetland protection and enhancement, and landscape amenities associated with the CRP. This requires the development and use of contingent valuation models which, while suffering from a host of biases and criticisms and involving an extensive commitment of resources, is the only method available to determine these values.
- *The effect of the CRP on the quality of ground and surface water used for drinking*. Studies examining the willingness to pay for cleaner drinking water already exist. To use these estimates, data are needed, for example, on the CRP's impact on groundwater pollutants, which involves the development of national-level physical-biological models on the transport of pollutants from the field to ground water.

Peter Feather (202) 694-5608, Daniel Hellerstein (202) 694-5613, and LeRoy Hansen (202) 694-5612
pfeather@econ.ag.gov
danielh@econ.ag.gov
lhansen@econ.ag.gov AO