Future Research Directions

As the Nation's largest user of land and water resources, agriculture significantly affects the natural environment. The Conservation Reserve Program is one of the more important mechanisms for mitigating the negative effects. The Federal Agriculture Improvement and Reform Act of 1996 (FAIR) encourages the USDA to use the program to achieve the greatest environmental benefits relative to costs. Targeting the program will be important to its future success.

This report describes how one can use natural resource valuation models, which are driven by observable public preferences, to select those program acres that maximize environmental benefits relative to cost. Using economics in environmental targeting requires an understanding of the extent to which nonmarket activities are sensitive to the location of CRP lands. The models developed here illustrate how "state of the art" models allow one to compute subcounty-level estimates of environmental benefits, both under current and alternative distributions of the CRP. With results at this level of geographic disaggregation, dollar-valued measures of the impacts of variations in targeting mechanisms (such as changes in an EBI) can be constructed, helping to shed light on critical environmental attributes.

This report focuses on three activities that the CRP affects: freshwater-based recreation, wildlife viewing, and pheasant hunting. Using currently available biophysical and economic data, we created several nonmarket valuation models that estimated how the net benefit (as measured by consumer surplus) of these activities is influenced by the current (circa 1992) CRP. We also used these models to investigate the environmental benefits of a simulated 34-million acre CRP generated from a recently employed EBI.

Although benefit estimates are not comprehensive, the output from these models provides several insights, including:

- The benefits associated with targeting CRP lands using a multi-objective EBI are substantially higher than those associated with targeting CRP lands using eligibility criteria based on erosion, as was done in early CRP signups.
- The CRP produces significantly larger benefits for wildlife viewing ($348 million per year) and for pheasant hunting ($80 million per year), than for freshwater-based recreation ($36 million per year). This difference is observed under both the "erosion" and "15th EBI signup" criteria.
- Natural resources that are near populated areas generate large benefits simply because more people can easily enjoy the resources. By favoring acres that generate positive impacts for more people, explicitly taking affected population into account when targeting CRP lands would increase the benefits of several types of outdoor recreation.

Our results suggest that it is feasible to develop a targeting system based on economic valuation models. However, to fully implement economic targeting of the CRP, research efforts are needed to (1) increase the number of environmental benefits that are evaluated; and (2) improve technical/theoretical approaches used to estimate the benefit models. Priorities in each of these areas are discussed below. Furthermore, some expected advances outside of economics and their importance to benefit estimation are also discussed to suggest additional directions that economic analyses may continue to improve.

Priorities in Environmental Benefits Related to Agriculture

To evaluate the CRP comprehensively, a number of improvements in available data, in modeling physical and economic relationships, and in statistical modeling are necessary.

What is needed:

- Obtain better and more complete survey data to determine all the benefits the CRP offers.
- Fully understand the impacts of the EBI.
- Incorporate new environmental goods and services into the EBI.
- Refine the estimated relationships between physical land characteristics and human well-being through advances in statistical and economic estimation techniques.

In addition, expanding the noneconomic knowledge base, as regarding how to measure and predict environmental changes as land-use policies change, can be expected to open new opportunities.

Other Environmental Benefits Recognized by the EBI

The EBI used in the 15th signup contains numerous factors that account for a range of environmental goods and services. Comprehensive analysis of the efficacy of the EBI requires some accounting for these goods and services. These include:

Wildlife. The wildlife models of this report did not incorporate a number of potentially important environmental goods and services, including:

- Other upland game species, such as quail and grouse. A derivative of the pheasant model, augmented by population estimates of these species, could be used to analyze these issues.

- Large game, such as deer and elk. A model fashioned after the wildlife-viewing model was estimated for large-game hunting, with inconclusive results. Future improvements, especially regarding resource availability and site choice, are required.

- Waterfowl hunting and viewing. Waterfowl impacts of CRP are geographically dispersed, and are ill-suited to the "local impact" analysis used in this report. A proper analysis requires construction of models that generate changes in waterfowl populations at sites throughout the Nation as the distribution of CRP changes (nationwide).

- The effect of trees on wildlife. Although the wildlife models include forest land variables, a better gauge should be developed that more closely links forest qualities to wildlife densities.

- Threatened and endangered species. Analysis of threatened and endangered species requires consideration of nonuse values, such as existence, option, and bequest values (Boyle and Bishop, 1987; Loomis and White, 1996).

- The effect of establishing native grass mixes on lands.

Ground-water quality. Ground-water quality does not directly affect recreational opportunities; however, it does have impacts (such as bequest values) that may be best quantified with nonmarket valuation techniques (Crutchfield, Cooper, and Hellerstein, 1997) or avoidance costs (Nielsen and Lee, 1987).

Long-term soil productivity. Standard economic theory suggests that long-term productivity impacts should be captured in land prices. However, differences between social and private discount rates (due to factors such as taxes or borrowing constraints), and the tendency of single producers to overlook widespread productivity losses when making production decisions, may lead to sub-optimal levels of soil protection. Public intervention may be justified to correct these problems (Boadway, 1979).

Wind erosion. To measure the benefit of reductions in wind erosion, better models of the geographic distribution of changes in air quality, given changes in land uses, are required. There is some promise that estimates from traditional air-quality models can be used (Huszar and Piper, 1986).

Priority areas. Conservation priority areas represent regions that are likely to have special features that yield extra benefits. Specifying and estimating nonmarket demands for these features allows the use of their values (rather than a "regional" correction).

Other water-quality benefits. Additional water-quality impacts may be substantial, including impacts to bays and estuaries, effects of coastal sediments on private and public water uses, and impacts of erosion on public works (such as dams and reservoirs).

Climate change. Significant organic matter buildup on CRP lands can sequester atmospheric carbon dioxide.

Environmental Benefits Not Recognized by the EBI

The EBI includes factors that are presumed to directly impact a number of environmental goods and services. However, many of these environmental goods and services were not considered when developing the EBI. In particular, scenic and existence values of rural landscapes were not considered.

The landscape variation imparted by the CRP may positively affect the scenic values of rural landscapes. This may be significant, especially in urbanized environments. Measuring such impacts is largely unexplored in the United States, though work in farmland preservation (and European work on cultural amenities) may be applicable.

Existence values of wildlife species, as impacted by the CRP, may also be quite large. Given that existence values may be held by a significant fraction of the U.S. population, even small, per individual values can yield large aggregate benefits. For example, the abundance of a variety of nongame birds is likely to have been increased by the CRP. Although some of these species may be enjoyed by bird watchers, it is possible that many people will value the fact that the environment is more conducive to avian species in general. In fact, there is evidence (Hagler Bailley, 1997) that many individuals hold non-negligible values for this "existence" value.

Improving the Technical and Theoretical Approaches

Technical advances in both behavior modeling and empirical approaches have been critical in allowing current research to provide more location-specific benefit estimates. Although research advances have resulted from agency efforts (Feather, Hellerstein, and Tomasi, 1997; and Hellerstein, 1992), advances have also been based on work outside of USDA/ERS.

The 1996 FHWAR survey will provide an immediate improvement in estimating benefits. This survey contains information that will improve the identification of sites visited by individuals. Since the location of a visited site underlies our measures of environmental characteristics consumed by a recreator, this will improve our modeling capability—both in terms of precision and scope. New sources of data will need to continue to address this need for precise geographic specificity. For example, due to the lack of precise information about site choice, longer trips were not analyzed (in either the water-quality or the wildlife models). Although longer trips do not comprise the bulk of trips taken, they may represent particularly high-valued trips. With better information on the location of long trips (as provided by the 1996 FHWAR), analysis of longer trips becomes feasible.

Expected Advances Outside the Area of Economics

Advances outside the area of economics are expected to provide a much-improved measure of the physical/environmental impacts of changes in agricultural land use. Improved computer capabilities will facilitate complex analyses of very large data sets. This includes applying improved geographic information systems (GIS) models to refine measures of environmental amenities.

This report uses environmental indicators instead of direct measures of biophysical impacts. The current indicators, while useful, are fairly simple. We expect richer sources of indicators to continue to develop, especially as GIS tools mature. In addition, research outside of economics is expected to continue to provide better models of environmental characteristics, such as how water quality and wildlife populations respond to changes in the CRP.

The Future of Environmental Targeting

Environmental targeting, as mediated through mechanisms like the Environmental Benefits Index, will always be a dynamic process. This report, which focuses on the use of the EBI to allocate CRP lands, illustrates the potential of economic analysis to provide objective assessments based on observable data. Based on the results in this report, we believe that economic valuation methods can contribute to the development of more refined targeting measures.

Further research will provide more comprehensive measures of the value of the CRP's environmental impacts. Better measures of biophysical responses are expected, and can affect direct measures of value (such as changes in recreational behavior due to CRP-induced changes in wildlife populations) and indirect measures (such as the existence value of rural wildlife that the CRP may augment).

Many of the prerequisites for future research are in place. Data that will help expand the analysis of CRP are becoming available, such as the 1996 FHWAR and a national contingent-value analysis of the value of Midwestern avian species. Biophysical models are also increasing in scope, such as USGS models relating stream quality to land uses. Lastly, continual improvements in the power of GIS data manipulations, and the refinement of comprehensive econometric models, should also help implement heretofore prohibitively complex models.