Targeting Resource Conservation Expenditures

Conservation program administrators must understand what they are getting — both out on the land and inside the Beltway.

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Payments to landowners are a major vehicle to assure resource conservation and environmental protection. Examples of payment programs are listed in the sidebar, page 34. Some of these programs (1, 2 and 3) compensate resource owners for changing resource uses while others (4, 5 and 6) involve the outright purchase of a resource. For example, the Conservation Reserve Program (CRP) has compensated landowners to retire 37 million acres of highly erodible cropland at a current annual cost of approximately $1.8 billion, and the Nature Conservancy has protected more than 11 million acres of environmentally valuable land in the United States through purchase or donation.

The main challenges for a program manager who wants to maximize environmental benefits are (1) to determine which resources to target for protection and (2) to decide how to allocate funds

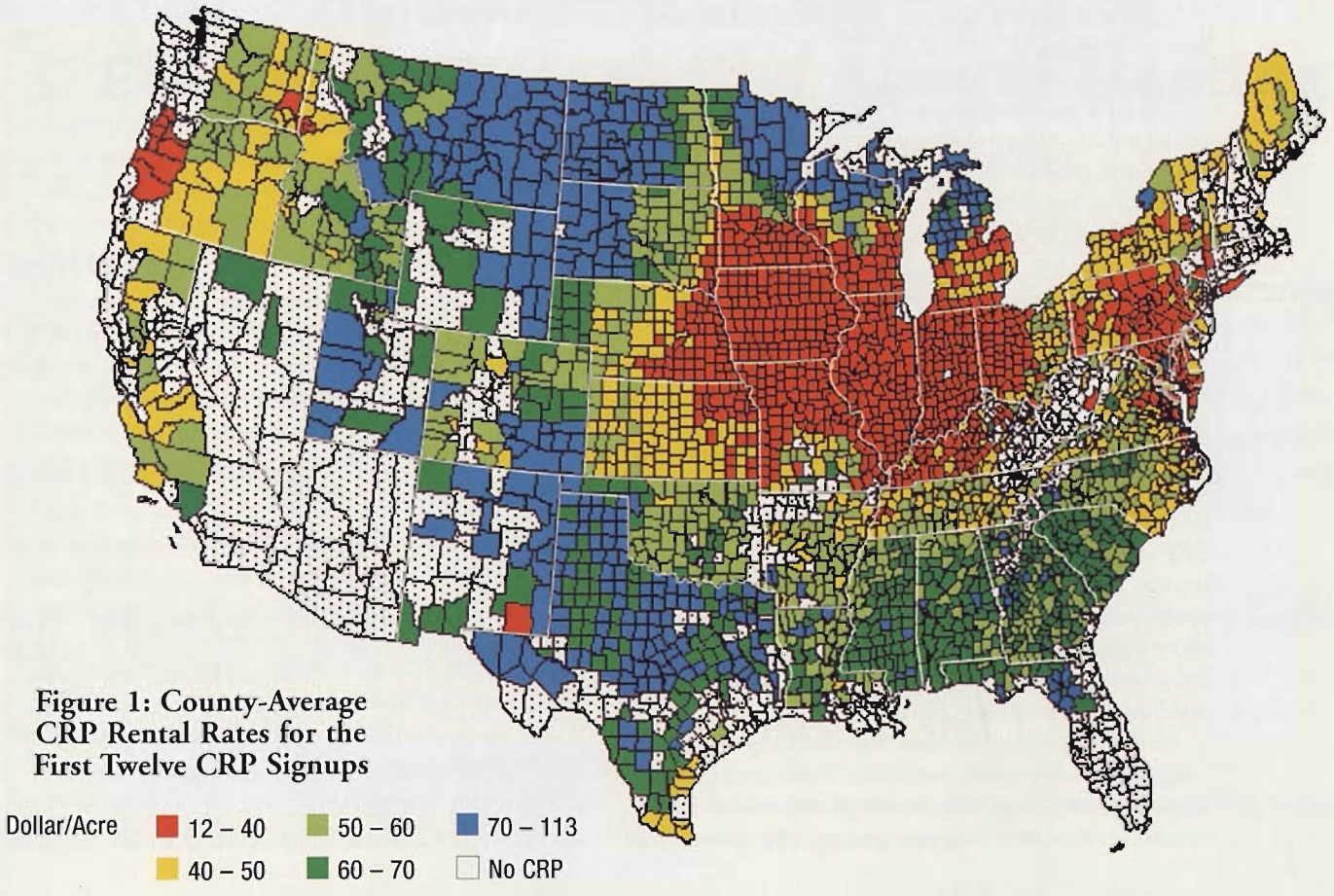


Figure 1: County-Average CRP Rental Rates for the First Twelve CRP Signups

among geographic areas. Three popular targeting criteria are:

- **Cost targeting** – using funds to purchase a specific resource at the least cost.
- **Benefit targeting** – using funds to purchase resources that provide the highest environmental benefit per resource unit.
- **Benefit-cost targeting** – using funds to purchase resources that provide the highest benefit per dollar expended.

The differences among these targeting criteria can be illustrated using a hypothetical example. Suppose there are three cropland parcels with annual rental rates of $100, $150, and $200, respectively. If retired from crop production, they will provide $100, $300, and $350, respectively, of environmental benefit per acre. If only one piece of land is targeted for a given conservation practice, then cost targeting would choose the first parcel because its rental rate is lowest. Benefit targeting would choose the third parcel because it provides the highest environmental benefit per acre, and benefit-cost targeting would choose the second parcel because it provides the highest ratio of environmental benefits to rental cost.

Cost targeting leads to purchase of resources that provide few environmental benefits, and benefit targeting leads to retirement of highly productive resources.

The CRP provides a practical example for the three targeting criteria. When the program began in 1986, environmental quality improvements were viewed as synonymous with a reduction in soil erosion. Program rules targeted benefits and restricted eligibility primarily to highly erodible croplands. This focus on soil erosion changed during the implementation process. The first nine signups of the CRP were subject to mandatory minimum annual enrollment levels established by the 1985 Food Security Act. In an effort to meet these enrollment levels, program administrators accepted bids as long as land eligibility criteria were met and the rental rate requested by the producer did not exceed the USDA maximum rental rate established for the area. The experience of CRP implementation before 1990 was consistent with acreage maximization (Reicheldefer and Boggess). In recent years, the CRP rule has moved toward benefit-cost targeting, where the benefit is measured using an Environmental Benefits Index that reflects the multiple environmental attributes of land.

Several recent studies have examined the designs of "targeted" conservation programs. Some focus on the economic, environmental, and/or distributional implications of alternative targeting criteria, and others focus

Examples of Programs that Purchase Environmental Assets

1. **The Conservation Reserve Program** aims to reduce soil erosion and increase wildlife and native plant habitats by retiring environmentally valuable cropland (highly erodible cropland prior to 1990). The current annual budget of the program is approximately $1.8 billion.
2. **The Environmental Quality Incentives Program**, established in the 1996 Farm Bill, targets "geographic priority areas" to "maximize environmental benefits per dollar expended," with an authorized budget of $1.3 billion (The Natural Resources Conservation Service, available at <http://www.nhq.nrcs.usda.gov/OPA/FB96OPA/MiscFB.html> January 28, 1999).
3. **The Conservation Reserve Enhancement Program** has recently allocated $500 million to the states of Oregon and Washington for salmonid protection.
4. **The Federal and State Governments** will pay $380 million for the purchase of the world's largest grove of old-growth redwood still in private hands, the Headwater's Grove, located on Pacific Lumber lands in Humboldt County, California (available at <http://www.ceres.ca.govcra/headwaters/faq.html> January 3, 2000).
5. **The Nature Conservancy** has protected, through purchases or donation, more than 11 million acres of environmentally valuable land in the United States and manages 1,340 preserves (The Nature Conservancy, available at <http://www.tnc.org/frames/index.html?/welcome/index.html> January 3, 2000).
6. **Debt-for-nature swaps** were developed to transform commercial debt of developing countries into finance for the environment. Since the first debt-for-nature swap was completed (for Bolivia, in 1987), nearly US$200 million of third world debt have been extinguished (The Conservation International, available at <http://www.conservation.org/ web/aboutci/strategy/dfswap.htm> January 3, 2000).

Figure 2:
Estimated County-Average Annual Water Quality Benefit Per CRP Acre for the First Twelve CRP Signups

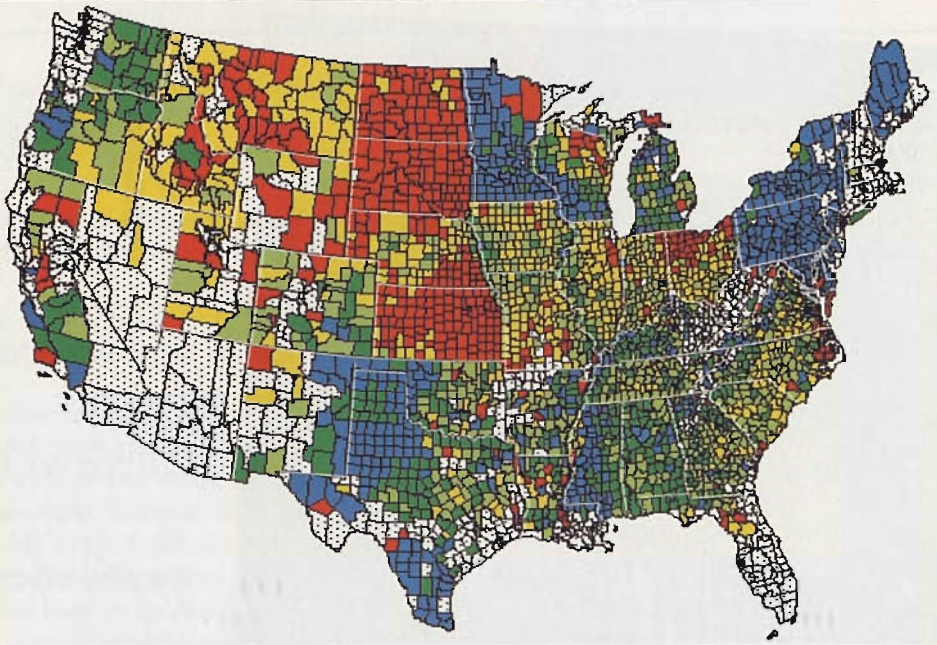


Figure 3:
Estimated County-Average Annual Water Quality Benefit Per CRP Dollar for the First Twelve CRP Signups

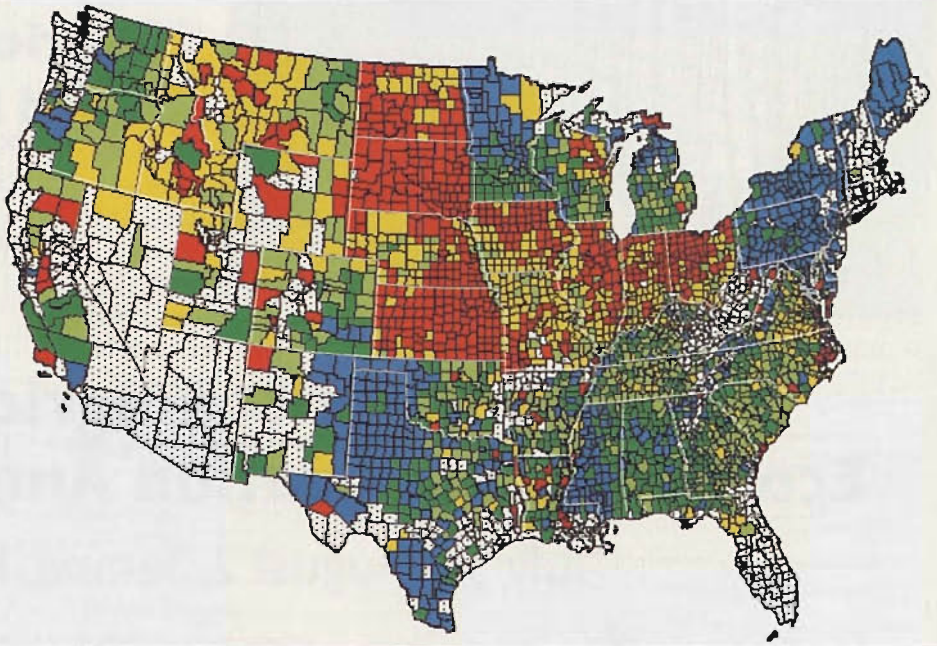
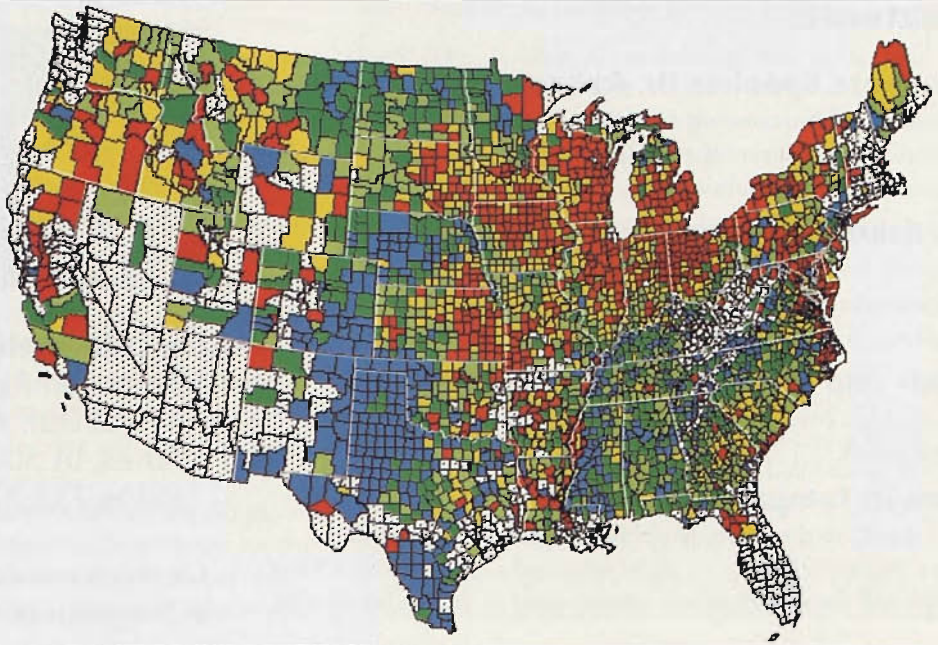


Figure 4:
Estimated County-Average Annual Soil Erosion Reduction Per CRP Acre for the First Twelve CRP Signups



on the allocation of funds among geographic areas such as watersheds or states. In what follows, we first review the key factors that affect the outcomes of alternative targeting criteria for a given area, and then discuss the key factors that affect the outcomes of fund allocation among geographic areas.

Factors Affecting Performance

The relationship between environmental benefits and the costs of purchasing those benefits affects the efficiency of a targeting criterion (Babcock et al.). If resources that provide a high level of environmental benefit are relatively inexpensive to purchase, then all three targeting criteria lead to the same outcome. However, if resources that provide a high level of environmental benefit are more costly to purchase, then use of cost or benefit targeting leads to inefficiency. Cost targeting leads to purchase of resources that provide few environmental benefits, and benefit targeting leads to retirement of highly productive resources.

The importance of the relationship between the number of environmental benefits and the cost of acquiring them can be illustrated using CRP as an example. Figure 1 shows the average CRP rental rates across counties for the first twelve signups. The average county rental rates range from $12 per acre to $113 per acre. Under cost targeting, counties in blue in Figure 1 (low cost per acre) are targeted first. Figure 2 shows the average annual water-quality benefits per CRP acre across counties. These benefits were estimated by multiplying the reduction in county-average soil erosion per CRP acre by the damages caused per ton of soil erosion as reported in Ribaudo (1989). Annual water quality benefit per CRP acre ranges from minimal to $946. Under benefit targeting, counties in blue in Figure 2 are targeted first. Figure 3 shows the county-average water quality benefit per CRP dollar. Under benefit-cost targeting, counties in blue in Figure 3 are targeted first. These figures show little correspondence among blue shaded areas. Under each specific targeting criterion, CRP dollars would be shifted from red-colored counties to blue-colored counties. Under benefit-cost targeting (Figure 3) some CRP dollars would be shifted from the Northern Plains and Corn Belt to the Northeast. This shift will not take place under cost targeting.

"Slippage" also affects the performance of a targeting criterion. Retirement of land and other resources reduces total production and increases output prices, which can lead to utilization of previously idle marginal resources. Wu estimates that for each one hundred acres of cropland retired under the CRP in the central U.S., 20 acres of non-cropland were brought into production, offsetting 9 percent and 14 percent of CRP water and wind erosion benefits, respectively. Similarly, Berck and Bentley estimate that including more acres of old-growth redwood in the Redwood National Park significantly increased redwood lumber price. The 1978 taking alone increased redwood lumber prices by 26 percent. These price increases lead to increased incentives to harvest old-growth redwood on unprotected lands. Ignoring the "slippage" effect of land retirement programs will reduce environmental gains and possibly make a program counterproductive (Wu, Zilberman, and Babcock). Reducing slippage may require targeting idle marginal resources to prevent them from entering production.

Factors Affecting Efficiency

The important factors that affect the efficiency of fund allocation among geographic areas include offsite environmental benefits, threshold effects of conservation efforts, and the relationships between alternative environmental benefits.

Threshold effects must also be considered in the design and targeting of conservation programs.

U.S. conservation programs have traditionally been targeted with onsite benefits in mind. The CRP was designed to prevent soil loss from land targeted as highly erodible. Applications for funding in USDA's Environmental Quality Incentive Program (EQIP) are often accepted based simply on the miles of streamside habitat protected or tons reduction in soil erosion. Increasingly, we know that conservation practices generate benefits both on and off the targeted site. Onsite benefits include reduced soil erosion and chemical loss that lead to increased farm productivity. Off-site benefits from the same programs may include water quality improvements, wildlife habitat enhancements, recreational opportunities, and human health protection. Growing evidence shows that offsite benefits from conservation may be greater than onsite benefits.

The importance of offsite benefits is demonstrated by Ribaudo's 1986 analysis of CRP targeting using both onsite and offsite benefits. He argues that if conservation programs are intended to maximize society's benefit, then both onsite and offsite benefits must be considered in the targeting criterion. This result can be illustrated using Figure 4, which shows county-average annual soil erosion reduction per CRP dollar. If maximizing tons of soil erosion reduction (an onsite measure) is the program objective, CRP dollars would be shifted from the Northeast to the Northern Plains. The opposite would happen if maximizing water quality benefits (an offsite measure) is the program objective (Figure 3).

Threshold effects must also be considered in the design and targeting of conservation programs. Threshold effects are present when a significant environmental improvement, such as the survival of a threatened species, can be achieved only after conservation efforts reach a certain level of

intensity (threshold). Such effects have been identified in many conservation efforts, particularly those involving fish and wildlife. The U.S. policy of targeting conservation programs on the basis of onsite criteria has caused programs to ignore threshold effects. Funds may be overly dispersed geographically, and funding levels in any given program area may be inadequate to reach the threshold needed for a significant environmental improvement. When the total budget is small, ignoring threshold effects may result in a substantial environmental benefit loss (Wu, Adams and Boggess).

Relationships among alternative environmental benefits should also be considered in the design and targeting of conservation programs (Wu and Boggess). The relationship can take two forms: interaction and correlation. Interaction refers to the causal relationships among alternative environmental benefits. For example, improved stream water quality enhances fish habitat. Correlation refers to the situation where two environmental benefits are jointly produced by the same conservation practice, although they have no causal relationship. For example, land retirements not only reduce soil erosion, but also protect groundwater quality. Babcock, et al., found that there are significant tradeoffs between environmental benefits when different targeting criteria are used in the CRP. Wu and Boggess show that ignoring the relationship may result in not only a misallocation of conservation funds among geographical areas, but also incorrect resources being targeted for conservation practices.

Future Challenges

The optimal design and targeting of conservation programs must recognize the complexity of ecosystems. While a lack of data from natural sciences often makes the design and implementation of highly effective programs difficult, research and advances in analytic tools, such as Geographic Information Systems, should improve the overall efficiency of conservation programs. The potential payoffs from such improvements are substantial, since the United States spends billions of dollars on conservation programs each year.

Political pressures pose another major challenge for the optimal design and targeting of conservation programs. Despite calls for "targeting" and "prioritizing," restrictions designed to spread funds more evenly over Congressional Districts and taxpayers often dictate the allocation of public conservation funds (Wu and Boggess). These restrictions are likely to result in efficiency losses. In addition, fund allocation is likely to be influenced by special interest groups that prefer and lobby for different targeting strategies. Wu, Zilberman, and Babcock showed that for a fixed budget, cost targeting results in the largest reduction in production and, thus, the largest increase in output prices. It should be favored by resource owners since both the resources retired and the resources remaining to be exploited will have higher market prices. Benefit targeting has the smallest impact on output price and overall resource use among the three strategies, because the cost of the targeted resources is not considered in the decision of which resources to purchase. This strategy should be favored by consumers and input providers. Benefit-cost targeting provides more environmental benefits than cost or benefit targeting when the output price is fixed. It should be preferred by environmentalists. However, when slippage is present, benefit-cost targeting no longer maximizes total environmental benefit for a given budget and should not be the preferred strategy for any group. Thus, it is not surprising that politics affect how conservation funds are allocated. Research that quantifies the economic and environmental tradeoffs involved under alternative targeting schemes can help policymakers design targeting schemes to meet broad public environmental goals. While the involvement of various interest groups will persist in federal funding programs, further economic analysis can serve to make the costs of alternative targeting schemes more transparent. ■

■ For more information

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