Government Decision Making and Program Performance: The Case of the Conservation Reserve Program

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Performance of the Conservation Reserve Program (CRP) in meeting the political preferences of its administrators is highly sensitive to the choice of eligibility, bid solicitation, and bid selection criteria used in making program implementation decisions. Decisions made in the first year of CRP implementation led to suboptimal results; net government cost could have been reduced while simultaneously increasing the extent to which erosion and supply control objectives were met. Simulation of the outcomes for a fully enrolled reserve under alternative implementation schemes indicates that future performance can be improved by manipulating key control variables to directly target preferences.

Key words: Conservation Reserve Program, government programs, public policy, soil conservation.

Farm program implementation is becoming more complex as the U.S. Department of Agriculture's (USDA) mandate is broadened and the opportunity for periodic program adjustment is increased. The 1981 and 1985 farm bills give the secretary of agriculture increasing discretionary power to make periodic adjustments in program instruments within a flexible set of policy guidelines. While earlier legislation tended to define precisely levels of farm support as well as the procedures for determining them, programs mandated by the 1985 Food Security Act, in particular, transfer much of the responsibility for adjustment in critical control variables, such as commodity loan rates and target prices, to the programs' administrators.

At the same time, farm legislation is evolving to address societal objectives which may go beyond the primary goals of the farm population. Also, budget constraints and recent farm program cost overruns make program cost reduction important to program decision makers. Thus, the administration may use its increasing discretionary powers to meet objectives that are different from, or even conflict with, farmer objectives.

The Conservation Reserve Program (CRP), mandated under Title XII of the 1985 Food Security Act, is a prime example of a program for which a number of critical decisions will affect the manner and degree to which multiple program objectives are met. In this article the USDA's CRP decision problem is reviewed, the sensitivity of CRP performance to alternative decision variables is tested, the cost effectiveness of 1986 program performance is compared with simulated alternatives, and implications are derived for improved decision making over the subsequent four years of CRP enrollment.

The stated objectives of the CRP are to (a) reduce water and wind erosion, (b) protect our long-term capability to produce food and fiber, (c) reduce sedimentation, (d) improve water quality, (e) create better habitat for fish and wildlife through improved food and cover, (f) curb production of surplus commodities, and (g) provide needed income support for farmers (U.S. Congress, 1985 Food Security Act). These objectives are subject to the specified constraints that a minimum of 5 million acres is enrolled in the reserve in 1986, enrollment in each of years 1987 through 1989 is at least 10 million acres, and no more than 25% of any one county's cropland may be enrolled.

Owners and operators of any cropland defined...
for CRP purposes as "highly erodible" may submit bids for enrollment of their eligible acreages. Enrollment into the CRP establishes a ten-year contract prohibiting haying, grazing, or commercial harvest of any crop and requires that the land be placed in a conservation use with adequate grass or tree cover. The government pays the amount of annual rent specified in accepted bids and provides half of the cost of establishing a vegetative cover. Enrollment in the CRP will be solicited through annual or more frequent sign-up periods between 1986 and 1990. The legislated goal is to enroll 40–45 million acres of highly erodible cropland by 1990.

The CRP Decision Problem

Administrators of the CRP are faced with a number of intertemporal choices mandated by the discretionary aspects of the CRP's underlying legislation. Their decision problem is broadly characterized by (a) a multiyear planning horizon, (b) annual or more frequent decision making, (c) probable strategic behavior by bidders, (d) multiple objectives, (e) political sensitivity, and (f) budget sensitivity.

CRP program administrators must select an operational definition of "highly erodible" which defines eligibility of land for the reserve and strategies for elicitation and selection of bids. Decisions regarding these factors may be made or changed prior to any announced sign-up period. Thus, within any period of time, the USDA's decision problem is one in which several key control variables may be manipulated to achieve performance levels for each objective which, in combination, satisfy political preferences.

Control Variables

The decision process involves three primary control variables: \( C_1 \), which establishes eligibility and defines the total number of acres eligible for CRP; \( C_2 \), which is the maximum bid level accepted or the strategy by which bids are selected; and \( C_3 \), the size of pool for bid selection.

Popular options for eligibility criteria (\( C_1 \)) include the following working definitions of "highly erodible" land: "3T", comprised of cropland in land capability classes (LCC) II–V which is eroding at greater than three times the tolerance level (\( T \)) and all cropland in LCC's VI–VIII (includes 69 million acres); "2T", comprised of cropland in LCC's II–V which is eroding at greater than two times the tolerance level (\( T \)) and all cropland in LCC's VI–VIII (includes 104 million acres); and \( EI \geq 8 \), all cropland with an erodibility index greater than 8—an indication of potential erosion (includes 118 million acres).

Many options are available for establishing bid selection criteria. Bids may be selected on the basis of their contribution to erosion reduction, the degree to which they reduce program crop base acreage, their rental cost, or numerous combinations of the erosion, supply, and rental cost values. Specific bid selection formulas can be used with or without an upper limit on rental fee bids.

The selection of a set of control variable levels constitutes an action, \( a \),

\[
a = C_2 \mid C_3 \mid C_1.
\]

This action, in turn, determines the extent to which each of the CRP's multiple objectives will be met.

Objectives and Performance Measures

Correct specification of program decision makers’ objectives is critical. Rausser suggests that this can be achieved by specifying a political preference function which reflects the multiplicity of objectives faced by agricultural policy decision makers and incorporates a weighting mechanism to represent the relative political importance of the various objectives. In applying this approach to Filipino rice policy decision makers, Rausser and Yassour find that policy performance is highly sensitive to the value of weights placed on each of the multiple objectives. Their analytical approach, however, requires that the direct effect of actions on outcomes can be estimated and presumes that a mechanistic weighting process is feasible for political decision making.

In the CRP, the basis for relating actions to outcomes does not exist for all program objectives. The direct, technical relationships between acres planted to crops and water quality, sedimentation, and fish and wildlife habitat rely on a number of

\footnote{The bid pool is a regional delineation of the area(s) that will receive acreage allotments for total bid quantities. Control involves deciding whether to solicit and select bids from a national pool or from sets of regional, state, or substate pools.}

\footnote{The erodibility index is constructed by dividing the contribution to soil erosion of a set of cropping and management factors by \( T \), the tolerance level of the soil which, based on physical factors, represents the annual amount of soil lost that can be tolerated without a loss in productivity. While "3T" is a subset of "2T", \( EI \geq 8 \) includes cropland that is not currently eroding at or above 2T. The \( EI \geq 8 \) land that does not overlap with the 2T set has the potential to erode at high rates but is currently being managed in ways that prevent excessive erosion.}
factors for which data are unavailable, tend to be site-specific, or cannot be specified at an aggregate, national level. However, it can be assumed that, in general, the greater the reduction in water and wind erosion, the greater will be the positive effects on the unmeasurable objectives of the CRP, including "long-term capability to produce food and fiber“ and environmental quality. Thus, two quantifiable CRP performance measures can be derived from the legislation: \( X_1 \), defined as tons per year of soil erosion reduction; and \( X_2 \), the reduction in commodity program crop supply (or commodity program cost savings).

Government-wide budget and political sensitivity imply two additional performance measures: \( X_3 \), the dollar value of CRP program outlays; and \( X_4 \), a vector of the spatial distribution of CRP acres (or program benefits).

**Political Preference**

The performance measure variables are hypothesized to contribute in the following way to political preference:

\[
U(a) = U(X_1, X_2, X_3, X_4),
\]

where \( U \) is utility and the levels of \( X_1 \) and \( X_2 \) are conditional upon program outlays \( (X_3) \).

Explicit recognition of the enrollment rates mandated by CRP legislation leads to the following definition of USDA’s decision problem:

\[
\text{max } U(a) = \max U(A, X_1, X_2, X_3, X_4),
\]

subject to

\[
A > A^*, \text{ and } \quad X_4 < X_4^*,
\]

where \( A \) is acreage enrolled, \( A^* \) is the minimum acreage required to meet an enrollment target, and \( X_4^* \) represents the restriction limiting enrollment to 25% of cropland per county.

The particular solution to the USDA’s CRP decision problem depends heavily upon the political preference that weights the importance of each of the program’s objectives. While central to the decision process, the weights associated with each CRP performance measure are uncertain, dynamic, and destined to remain implicit. The weights are a function not only of the administration’s goals but also reflect the effect of political pressure in modifying those goals. At the CRP’s outset in 1986, the USDA had little or no information on which to base its expectations of farmer receptivity or public response to the program. This uncertainty has affected the decision process and resulted in a period of experimentation with alternative actions (e.g., changes in eligibility criteria have been made and a bonus offered in one signup period for corn base acreage). In addition, preferences can easily shift over time. A new set of actors may be selected in 1988 to complete implementation of the CRP. In any one budget year, Gramm-Rudman-Hollings deficit reduction procedures may constrain the program outlay performance measure variable \( (X_3) \). And, because articulation of weights would invite response from interest groups with different preferences, USDA’s preferences are more often revealed through actions than announcements.

In the sections that follow, two analyses are presented—one of actual CRP performance in 1986 and one of potential performance of a fully enrolled CRP. These analyses help to determine whether preferences have been revealed, if the reserve is cost effective, and what initial performance implies for future CRP decision making.

**CRP Implementation in 1986**

In the early stages of CRP initiation, two control variables, eligibility \( (C_1) \) and bid pool size \( (C_3) \), were fixed in the short run. For 1986, eligibility was restricted to “3T” cropland. The bid pools established for CRP bid solicitation and allocation in 1986 were defined by substate regions in order to assure a relatively equitable distribution of program benefits among congressional districts.

Once eligibility criteria and bid pool size were established, remaining decisions focused on the criteria for bid selection. Bid selection in 1986 was based on whether or not bids met predetermined (but unannounced) caps on rental fee levels. The rental fee caps were based on average cropland cash rent in the pools and ranged from \$20 to \$90. All bids at or below the cap on rental fee were accepted.

**CRP Performance in 1986**

Bidding was active under each of three sign-up periods conducted in 1986. The March, May, and August sign-up periods resulted in 44,487, 32,113, and 41,997 submitted bids representing 4.8, 4.7, and 6.4 million acres, respectively. Of total bids submitted, 23%, 66%, and 80% were accepted in the March, May, and August rounds, respectively.

CRP performance in 1986 showed both significant erosion reduction and supply control. The three rounds of bidding resulted in enrollment of 8.9
million acres, with an annual average of 25 tons of soil erosion saved per acre, and over 60% of the acres enrolled were reductions to commodity program acreage bases. These results were achieved at an annual, total rental cost of $408 million.

Concern with (thereby high implicit weighting of) the budget performance measure \(X_3\) was especially apparent in USDA in 1986. This concern related to the total value of CRP outlays, and to the net cost of CRP implementation. The reserve, by offsetting highly erodible land, has the potential to offset Commodity Credit Corporation (CCC) outlays made in the form of deficiency payments. This potential arises from direct and indirect commodity program cost savings. Direct cost savings accrue in the form of base acreage reductions required for CRP enrollment by commodity program participants. Consequently, the acreage eligible for deficiency, diversion, and related payments is reduced.

In addition, if the CRP is effective in reducing aggregate production of program crops, market prices may rise and deficiency payments levels decline. Hertel and Preckel’s findings indicate the indirect commodity price effects of an 8.9 million-acre reserve are likely negligible. Thus, the following assessment is limited to direct commodity program cost savings.

In addition to CCC savings, the CRP should result in conservation program savings. As fewer highly eroding acres remain in production, the demand for conservation technical assistance and Agricultural Conservation Program (ACP) cost-share funds will decline, although some of this decline may be offset by the income effects of the CRP which stimulate demand for conservation investment.

Data on actual bids were used to examine the effect of alternative bid selection strategies on principal performance measures, including the net cost of the CRP in its first year, to determine whether performance with respect to program cost savings could have been improved. The supply control cost savings associated with each CRP bid were calculated by multiplying the bid’s reported base reductions for each program crop times reported program crop yield and then multiplying this product times the net CCC program cost per unit of crop. The result is a dollar value reflecting the estimated total, direct commodity program cost savings associated with each bid.

In an evaluation of traditional erosion control programs, Strohbehn reports the erosion reduction achieved and total social costs and benefits associated with the Conservation Technical Assistance, Great Plains Conservation, and Agricultural Conservation Programs in 1983. Erosion control benefits considered by Strohbehn include the estimated value of maintaining long-run productivity of the soil, reducing sedimentation in navigational channels and in water storage and flood retention reservoirs, and improving water quality and fish habitat.

Erosion control program cost savings associated with a CRP bid were estimated by multiplying the net erosion reduction for the land bid times the appropriate erosion control cost per ton reported by Strohbehn. These erosion control cost savings may overestimate the actual savings if some of the saved resources are needed to administer the CRP.

**Actual versus Potential Cost Savings in 1986**

Estimates of commodity and conservation program cost savings were assigned to the complete sets of CRP bids received in March, May, and August 1986 and used to calculate the net public cost of the reserve as it was operated in 1986 and under alternative bid selection criteria.

In terms of the utility maximization problem, the effect of control variable \(C_2\) on various combinations of performance measures was tested. The alternative bid selection strategies included the following: (a) Maximize erosion reduction per dollar, whereby bid selection is made by pool on the basis of highest to lowest reported erosion rates per dollar of bid; this is equivalent to maximizing \(X_3/X_2\). (b) Maximize supply control per dollar, which selects bids from pools on the basis of from highest to lowest associated supply control cost savings per dollar of bid and is equivalent to maximizing \(X_2/X_3\). (c) Minimize net cost per ton of erosion, which selects bids from pools on the basis of lowest to highest net program outlays per ton of erosion reduction.

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3 The reduction in cropland base and allotment history, during the life of the contract, is proportional to the ratio between acreage placed in the reserve and total cropland acreage on the farm for those crops which have production adjustment programs in place. The distribution of base reduction among multiple crop bases is left to the discretion of the landowner or operator.

4 Estimates of projected average price support and related CCC expenditures (deficiency, diversion, storage, and loan payments) by program crop were obtained from the president’s budget (Executive Office of the President). The projected 1986–90 average program outlays range from $4 per bushel for oats to $1.02 per bushel of wheat. This reflects the legislated intent to reduce the difference between loan rates and target prices over the period 1985–90. In the case of peanuts and tobacco, the reported base reductions are multiplied by a per acre CCC program cost.

5 Net erosion reduction values were estimated for each bid by subtracting an estimated after-control erosion rate of 3 tons per acre from the bid-reported prior erosion rate. If the reported prior erosion rate was 3 tons or less, no adjustment was made. For bids of land on which erosion rate was reported as unknown, the associated state mean prior erosion rates were used.
duction, where net cost per ton is estimated as \((X_3 - X_2)/X_1\). These were compared with the strategy actually used to select bids in 1986. To glean some knowledge of the implicit weighting of preference between erosion \((X_1)\) and supply control \((X_2)\), a fixed total program expenditure level \((X_3)\) was used for each sign-up period. This allows insight into the effects of different preferences on performance measures without a change in the actual outlays made for CRP land rental. Rental costs were fixed at $35 million for selection from bids submitted in March and at $133 and $240 million for selection from May and August bids, respectively. These amounts reflect actual expenditures in 1986.

In table 1, results of actual CRP enrollment are compared with the outcomes that would have been achieved, at identical cost, for all bids received in 1986 under the different selection criteria. The strategy followed in 1986 enrolls the greatest number of acres for a given program outlay. However, the erosion reduction and supply control accomplished through retirement of the low rent acres are less than under alternative bid selection criteria. Maximizing erosion reduction per dollar increases erosion control benefits of a CRP, but these benefits are offset by a reduction in supply control cost savings. Likewise, maximization of supply control benefits involves a tradeoff in erosion reduction. Minimizing net cost per ton of erosion reduction retains high supply control benefits and low per acre net program costs but also performs well in achieving high levels of erosion reduction. It has the lowest net program cost of the alternatives examined. This comparison implies that CRP implementation in 1986 presented opportunities for reducing the net public cost of the program as well as increasing the levels of program performance per dollar outlay.

USDA’s 1986 choice of bid selection criteria reveals an attempt to maximize acreage enrolled in the CRP \((A)\). But the acres enrolled do not represent the subset of submitted bids that would have contributed the most erosion reduction or supply control. From this finding, it appears that maximization

### Table 1. Analysis of Alternative CRP Bid Selection Criteria Using State-Substate Pools: Summary of the March, May and August 1986 Bids

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Selection Criteriaa</th>
<th>Maximize Erosion Reduction per Dollar</th>
<th>Maximize Supply Control per Dollar</th>
<th>Minimize Net Cost per Ton Erosionb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acres accepted (thou.)</td>
<td>Actual</td>
<td>8,913</td>
<td>8,471</td>
<td>8,267</td>
</tr>
<tr>
<td>Rental costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (million $)</td>
<td>408</td>
<td>408</td>
<td>408</td>
<td>408</td>
</tr>
<tr>
<td>Per acre ($)</td>
<td>46</td>
<td>48</td>
<td>49</td>
<td>48</td>
</tr>
<tr>
<td>Erosion reduction</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (million tons)</td>
<td>226</td>
<td>226</td>
<td>201</td>
<td>255</td>
</tr>
<tr>
<td>Per acre (ton)</td>
<td>25</td>
<td>31</td>
<td>24</td>
<td>30</td>
</tr>
<tr>
<td>Cost/ton of erosion ($)</td>
<td>1.80</td>
<td>1.53</td>
<td>2.03</td>
<td>1.60</td>
</tr>
<tr>
<td>Supply control savings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (million $)</td>
<td>157</td>
<td>151</td>
<td>192</td>
<td>177</td>
</tr>
<tr>
<td>Per acre ($)</td>
<td>18</td>
<td>18</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td>Erosion control cost savings</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (million $)</td>
<td>127</td>
<td>133</td>
<td>115</td>
<td>131</td>
</tr>
<tr>
<td>Per acre ($)</td>
<td>14</td>
<td>16</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Net Program Costs</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rental net of supply control benefits ($/acre)</td>
<td>28</td>
<td>30</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td>Rental net of supply control and erosion control savings ($/acre)</td>
<td>14</td>
<td>15</td>
<td>12</td>
<td>12</td>
</tr>
</tbody>
</table>

a All criteria assume a total expenditure of $408 million.
b Net costs are defined as rental cost minus supply control benefits.
of political preference was superseded by the constraint that acreage enrollment must be greater than or equal to a minimum target level. In other words, the risk of undershooting mandated enrollment for 1986–87 may have outweighed performance measures in the decision process. The need to meet acreage targets coupled with concern over program costs resulted in multiple rounds of bidding and a selection process that minimized rental rates.

This analysis of 1986 bids focused only on the implications of changes in a single control variable, the bid selection strategy ($C_2$). Because eligibility was fixed at “3T”, actual bid data could not be used to judge the implications of decisions on the eligibility control variable ($C_1$). In the longer run, both eligibility and bid pool size ($C_3$) can be varied. In the following section, the sensitivity of a fully enrolled conservation reserve to variation in all three principal control variables is examined.

**Simulated Program Performance**

The overall sensitivity of CRP performance to critical decisions on control variable levels was tested by simulating the outcomes of a 40-million-acre reserve under alternative combinations of eligibility, bid selection criteria, and bid pool size. In reality, control variables may be manipulated and their levels changed for any program sign-up period, thus creating a dynamic decision problem. However, in order to estimate the static, independent and interactive effects of control variables on performance measures, each control variable level was assumed the same over all sign-up periods. The simulation described as follows is, thus, static and deterministic.

**Procedures**

The physical erosion and land use characteristics of U.S. cropland are described by the 1982 National Resources Inventory (USDA, Soil Conserv. Serv. 1984). The National Resources Inventory (NRI) data contain the distributions, by state and land resource group (defined in the appendix), of cropland that would be eligible for the CRP under each of three eligibility criteria: “3T”, “2T”, and $E1\geq8$. For each eligibility-based distribution of cropland, data on erosion and productivity by state and land resource group (LRG) were merged and the cash rent value associated with each LRG-state combination of eligible cropland was estimated. Estimation procedures are described in the appendix. The result was construction of three data bases, each of which contained 348 sets of land from which CRP bids could arise. Location, productivity, erosion, and cash rent vary among each of the 348 sets of land within an eligibility-based distribution. The quantity of eligible land in a particular LRG-state set of cropland varies across eligibility criteria.

CRP bid levels are assumed to be a direct function of cash rent received for the land, i.e., a measure of income generating potential which incorporates both the productivity and uses of the land. Accordingly, bid levels by LRG-state set of cropland for each eligibility definition were estimated as

$$B_{jk} = \alpha(R_{jk} + V_k),$$

where $B_{jk}$ is the expected mean CRP bid for cropland in LRG $j$ in state $k$; $\alpha$ is a parameter; $R_{jk}$ is estimated mean cropland cash rent for set $jk$; and $V_k$ is the mean annual, discounted, farmer share of cover establishment and maintenance cost for state $k$. The parameter, $\alpha$, reflects desired compensation for commodity program losses, expected increases in net returns, and resource immobility costs. A value of 1.25 was calculated for $\alpha$ from 1986 bid data.6

To simulate the outcome of various decision rules for CRP bid selection, the LRG-state sets of cropland for a given eligibility definition were sorted by relevant performance measures. For example, simulation of bid selection based on rental cost minimization (as reflective of performance measure $X_3$) was initiated by sorting the 348 sets of cropland from lowest to highest mean bid ($B_{jk}$). The simulation program sequentially selected LRG-state sets of cropland in order of their ranking by performance measure until 40 million acres were accumulated for simulated enrollment in the CRP.

Five alternative bid selection control variables ($C_2$) were simulated for each of three eligibility ($C_1$) and two bid pool size ($C_3$) control variable levels. The simulated bid selection criteria included the same “maximize erosion reduction per dollar” option that was used to analyze 1986 bids. The limitations imposed by simulated rather than actual bid data required a modification (from the 1986 bid analysis) of additional bid selection possibilities, as follows: (a) Minimize rental cost, which selects LRG-state sets of cropland in order of lowest to

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6 The value of $\alpha$ depends upon risk preferences, expectations, and financial conditions of CRP bidders. In lieu of data on these factors for direct estimation of $\alpha$, the actual premiums implicit in March, May, and August 1986 bids were calculated by dividing average bid values by average estimated cash rent and cover costs.
highest mean bid \((B_{jk})\) as a way of minimizing program cost \((X_3)\). (b) Maximize supply control potential, which selects LRG-state sets of cropland in order of highest to lowest associated yield index \((Y_{jk})\) as a proxy for maximizing supply control savings \((X_2)\). (c) Maximize erosion reduction, which selects sets of eligible cropland in order of highest to lowest erosion rate \((X_1)\). (d) Maximize supply control potential per dollar, which selects sets of eligible cropland in order of highest to lowest ratio of yield index to bid value \((Y_{jk}/B_{jk})\) as a proxy for maximizing supply control per dollar \((X_2/X_3)\).

Simulation of state-level bid pools required that the percentage of selected acres from each state be constrained to equal the proportion of total national eligible acreage contained in that state. There were no constraints on location of selected cropland for simulations that assumed a national bid pool.\(^7\) Total erosion and average yield index performance measures were calculated for the sets of cropland selected for each simulated combination of eligibility, bid selection, and bid pool size control variables. The total program outlay performance measure was calculated by assuming that equal proportions of land from each LRG-state set of cropland are enrolled each year, such that 5, 10, 10, 10, and 5 million total acres are enrolled in 1986 through 1990, respectively. CRP cost estimates were maintained in current dollars. The currently anticipated real, long-term interest rate for government expenditure, 4% (Economic Report of the President), was used to calculate the present value of accumulated annual rental plus establishment costs over the life of the reserve.

**Simulation Results**

The differences in performance measures \((X_1, X_2, X_3)\) among various eligibility criteria \((C_1)\) and state versus national bid pool size \((C_3)\) when bids are selected on the basis of low rental cost are shown in table 2. Under this selection criteria, the \(EI \geq 8\) definition provides the greatest erosion control. The ‘‘2T’’ definition has the lowest program costs when bids are selected from a national pool, but total program costs are insensitive to eligibility criteria when state pools are used.

State bid pooling enhances supply control aspects of the CRP without sacrificing erosion control benefits. It places a heavy weight on the distribution performance measure \((X_4)\) in meeting preferences. However, the direct program cost of assuring that CRP benefits are equitably distributed among states ranges between $6−$10 billion. By the same token, state pools result in greater supply control cost savings, which will partially offset these additional direct program costs. The simulated impact is consistent with the findings of Ervin, English, and Johnson, who report that forcing the land enrolled to reflect the distribution in eligible land results in a higher program cost. They also show that eligibility criteria play a prominent role in determining regional conservation reserve enrollment patterns.

The effects of using alternative bid selection criteria are shown in table 3. For a nationally pooled reserve drawn from \(EI \geq 8\) cropland, selecting bids to maximize erosion reduction would improve program performance by 3 to 12 tons of soil savings per acre per year over other bid selection alternatives. Selecting bids to maximize either erosion reduction or supply control potential significantly raises program cost over the strategy of minimizing rental payment. Maximizing supply control potential is most expensive. But if bids were selected to maximize supply control potential, the acreage set aside in the CRP would be highly productive, with yields 13% higher than the national average.

If budget exposure is considered jointly with either erosion control or supply control (columns 4 and 5, table 3), the simulated net cost is much lower than for the unconstrained erosion or supply control criteria. Maximizing the constrained erosion control performance measure costs 31% less than unconstrained erosion control, but 8% less erosion reduction is achieved and the land retired is 12% less productive. Similarly, maximizing the constrained supply control performance measure is 63% cheaper than maximizing the unconstrained supply control objective. In this case, erosion reduction increases 20%, but average crop yield index of the retired land declines by one-third compared to the unconstrained supply control objective.

Simulation results suggest that a CRP bid selection strategy which realizes the supply control potential of the program could substantially reduce supply control program costs. These cost savings, however, depend upon the amount of program crop base acreage bid into the reserve.

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\(^7\) This process precludes imposition of the 25% per county limitation (or the \(X_3\) constraint in terms of the conceptual model). However, it is unlikely that this limitation will affect either the relative magnitude of difference among simulated implementation options or actual CRP enrollments patterns. Nationally, less than 10% of total cropland will be accepted into the reserve. In only 9 states does total CRP-eligible acreage \((at EI \geq 8\) eligibility) exceed 25% of total cropland (Soil Conserv. Serv., NRI summary). There are no statistically valid data on county-level eligible acreage. Our simulation of state-level pools is unlikely to violate the 25% limitation. National pool simulations are more likely to violate the limitation; nonetheless, the 25% maximum seems not to have been enforced. Following 1986 sign-ups, a number of counties already exceeded the limit and the limit seems unlikely to be enforced unless pressure is exerted by local communities.
Table 2. Simulated Performance of a 40-Million-Acre Reserve, Given Alternative Eligibility Criteria and Bid Pool Sizes for Bid Selection on a Low Rental Cost Basis

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>National Pool</th>
<th>State Pools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>≥3T</td>
<td>≥2T</td>
</tr>
<tr>
<td>Average rental fee ($/acre)</td>
<td>41.28</td>
<td>33.77</td>
</tr>
<tr>
<td>Average cover cost ($/acre)</td>
<td>4.79</td>
<td>3.91</td>
</tr>
<tr>
<td>Total, discounted program outlay (billion $)^a</td>
<td>14.2</td>
<td>11.6</td>
</tr>
<tr>
<td>Average erosion reduction (ton/acre/year)</td>
<td>26</td>
<td>21.5</td>
</tr>
<tr>
<td>Average program crop yield index for land in reserve^b</td>
<td>.74</td>
<td>.64</td>
</tr>
</tbody>
</table>

^a Discount rate is 4%.

^b Yield index, where weighted average national yield of program crops (barley, oats, corn, sorghum, wheat, and cotton) equals 1.0.

Table 3. Simulated Performance of a 40-Million-Acre Reserve, Given EI>8 Eligibility and Alternative Bid Selection Criteria for a National Pool

<table>
<thead>
<tr>
<th>Performance Measure</th>
<th>Minimize Rent</th>
<th>Maximize Erosion Reduction</th>
<th>Maximize Supply Control Potential</th>
<th>Maximize Erosion Reduction per Dollar</th>
<th>Maximize Supply Control Potential per Dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average rental fee ($/acre)</td>
<td>34.10</td>
<td>56.05</td>
<td>99.48</td>
<td>38.05</td>
<td>36.64</td>
</tr>
<tr>
<td>Average cover cost ($/acre)</td>
<td>4.17</td>
<td>5.82</td>
<td>7.82</td>
<td>4.61</td>
<td>4.7</td>
</tr>
<tr>
<td>Total, discounted program outlay (billion $)^a</td>
<td>11.8</td>
<td>19.1</td>
<td>33.2</td>
<td>13.2</td>
<td>12.8</td>
</tr>
<tr>
<td>Average erosion reduction (ton/acre/year)</td>
<td>28</td>
<td>37</td>
<td>25</td>
<td>34</td>
<td>30</td>
</tr>
<tr>
<td>Average program crop yield index for land in reserve^b</td>
<td>0.66</td>
<td>0.80</td>
<td>1.13</td>
<td>0.70</td>
<td>0.75</td>
</tr>
</tbody>
</table>

^a Discount rate is 4%.

^b Yield index, where weighted average national yield of program crops (barley, oats, corn, sorghum, wheat, and cotton) equals 1.0.
Interdependence of Control Variables

CRP performance is highly sensitive to the choice of control variables, and the effects of control variables on performance are interdependent. The effectiveness of one variable on a given performance measure is conditional on the levels of the other two variables. For example, the effects of bid selection formulas are particularly dependent upon eligibility criteria.

The bid acceptance strategy used in 1986 was successful in initially enrolling required acreage at low rental cost, but its longer term effectiveness is questionable. It is assumed that a rational bid is based in part on cover establishment and maintenance costs and includes a risk premium in addition to the opportunity cost of the land bid. Therefore, restricting acceptance to bids that are less than or equal to average cash rent means that to be accepted bidders must either (a) bid land that has a below average value or (b) be willing to accept less than a breakeven fee for retiring the land. In fact, analysis of bid data showed that bidding was most active in pools where dryland acreage in irrigated areas could be enrolled at bid levels that exceeded average dryland cash rent but were well under average rental caps for the pool. The question of how many more acres can be enrolled under these circumstances is important. The analyses reported herein suggest that future performance can be improved by the adoption of bid selection criteria that directly target desired performance measures. Results also suggest that eligibility criteria can limit the use of bid selection formulas to increase program performance.

The proportion of total bids accepted to meet enrollment targets has a direct impact on the effectiveness of formulas to target bid selection. If every acre bid is needed to meet acreage allotments, formula use is a moot point. The smaller the percentage of bids that must be selected, the greater the effectiveness of formulas in targeting desired acreage. This relationship can be tested by comparing relative performance under alternative bid selection criteria for March and later 1986 enrollments. In March, only 17% of acres bid were accepted under a low rental cost criterion. The 83% difference between bids submitted and bids accepted provided significant leeway in the choice of acceptable bids. Thus, the relative differences among performance levels under alternative bid selection criteria were large (Dicks, Reichelderfer, and Boggess). By August, the distribution of bid offers had narrowed, and a greater number of acres had to be enrolled to start meeting 1987 goals. As a result, 56% of all acres bid in 1986 were accepted, and the relative differences in performance levels among bid selection criteria (see table 1) are less than those observed for March bids alone.

The relationship between effectiveness of bid selection criteria and the proportion of bids that must be accepted suggests that the opportunity for increasing CRP performance depends upon both the number and distribution of bids received. The greater the number and the wider the distribution of bids received in any one sign-up period, the greater the effectiveness of a formula in targeting desirable acreage for enrollment. The number of bids received is influenced by eligibility as well as by other program benefits and costs. Broadening eligibility, lowering commodity program benefits, and/or better advertising of the impending costs of conservation compliance should encourage more CRP bids per sign-up. Increased numbers of bids will not only enhance the effectiveness of bid selection formulas but also may lead to more competitive bidding behavior, which lowers the mean bid level and indirectly reduces total program cost.

Concluding Comments

Government program implementation is becoming increasingly complex as the number of actors involved in and objectives for “farm programs” grow. The evidence suggests that implementation of the CRP in 1986 was suboptimal in the sense that the net government cost of the program could have been reduced while simultaneously increasing the level of erosion reduction and supply control achieved. Improvement in program implementation will require government decision makers to identify the control variables available and to analyze the impact of variations in the control variables on program performance. In the case of the CRP, it is clear that eligibility, pooling, and selection criteria can be manipulated to alter program performance. However, the interdependence of control variables suggests that actions must be carefully constructed from available program instruments, and the dynamics of political preference require that actions allow some flexibility. Furthermore, the relationship between CRP and other farm programs must be considered. These factors may help explain why eligibility was restricted to the smallest set of acreage and acceptable rental

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5 The Conservation Compliance provision of the 1985 Food Security Act denies farm program eligibility to any owner or operator of highly erodible land (defined as $E_i \geq 8$) who, by 1990, has not implemented an approved soil conservation plan on the land.
fees were low in the initial rounds of CRP sign-up. This facilitates future expansion and flexibility.

A host of other factors may affect the potential success of CRP control variable manipulation, even under the most stable government preference function. Farmers’ decisions regarding CRP participation are strongly affected by foregone commodity program benefits due to partial retirement of their cropland base in the reserve (Boggess). This affects program decision making in two ways: through comparative static interaction with commodity programs and through adaptive expectations by private and public decision makers.

High commodity program benefits are a disincentive for participation in the CRP at current levels of accepted bids (Esseks and Kraft). As long as CRP benefits are low relative to commodity program benefits, commodity programs will pose strong competition with the CRP and the CRP may not enroll a large quantity of base acreage. This competitive interaction is critical to many long-range land retirement schemes (Jagger and Robinson) and may be used to improve CRP land-targeting schemes (Taff and Runge).

As bidding proceeds over time, observed decisions by CRP administrators and farmer bidders in one period likely will contribute to both parties’ expectations in the next period (Reichelderfer). In fact, there is evidence of Bayesian learning between the sign-ups in 1986. Both the mean value and distribution of bid levels declined between March and May and between May and August, implying that bidders had learned an acceptable bid level. At the same time, CRP administrators raised the average cap on rental fee bids between March and May and between May and August, implying that the USDA learned how to accommodate bidding behavior. The implication of this adaptation pattern is that it can lead to strategic behavior which affects the hypothesized relationship between $B_{jk}$ and $X_{3}$. For example, bidders with lower-than-average valued land may offer average value bids with an expectation that they will be accepted. This situation can be overcome by incorporating variables other than bid levels into the criteria for bid selection.

The social economic efficiency implications of supply control versus erosion control are also important to consider. While both have government cost dimensions, commodity program savings, except for deadweight loss reductions, are simply transfers. Erosion control benefits, on the other hand, provide surplus to a broad constituency and therefore are likely to be real economic efficiency gains. Extension of the analysis to incorporate such considerations would require comparison of the social welfare implications of alternative government decisions.

The challenge in implementing government programs lies in ascertaining the relative preferences among specified multiple objectives. During implementation of the CRP, various actors lobbied for different weighting schemes on the various program objectives. The difficulty now lies in charting a path that will satisfy the preferences of CRP administrators and CRP constituents in meeting, to various degrees, each of the program’s objectives and constraints.

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References


Appendix

Study Data

In order to simulate CRP performance, measures of erosion, productivity, and value of land enrolled in the reserve were required. Accordingly, data from three sources were merged: the 1982 National Resources Inventory (NRI); EPIC, an Erosion Productivity Impact Calculator (Williams); and the 1986 Agricultural Land Values Survey.

The cropland data base for CRP simulation contains NRI data on the physical erosion and land use characteristics of U.S. cropland (USDA, Soil Conserv. Serv., 1981) and EPIC-generated data on crop yield potential for NRI points. These data were used to build, for each definition of “highly erodible,” a data set of unique bundles of land that meet the particular CRP eligibility criteria. Each “bundle” is comprised of all eligible cropland in a Land Resource Group (LRG) within a state. There are 348 LRG-state bundles of land per eligibility definition (48 states, with 7–8 LRG’s per state). The average erosion rate for each “bundle” is determined from NRI; the average crop yield index from EPIC. Both erosion and yield indices vary by LRG within a state.

Calculating the cost of a reserve requires estimates of the rental fee bid associated with each set of eligible acreage. A 3-stage process was conducted to estimate CRP bid levels as a function of cash rent for each LRG-state bundle of cropland. First, county-level cash rent estimates were obtained from the Economic Research Service’s 1986 Agricultural Land Values Survey. The county-level estimates were weighted and aggregated to 131 Major Land Resource Areas (MLRA’s). Each member of this set of average cash rent estimates included a sufficient number of observations to be statistically valid and represented a distinct geophysical area. However, these sets do not differentiate cash rent by state or LRG, nor do they reflect differences in cash rent associated with varying production potential (represented by yield indexes in the cropland data base) within an MLRA. Consequently, additional operations were performed, as follows, to associate cash rent directly with LRG-state bundles.

To determine the contribution of yield potential to cash rent, in units that could be applied directly to individual states, cash rent was estimated as a simple function of EPIC-generated yield index by MLRA for each of USDA’s ten major production regions:

\[
R_{im} = b_i(Y_{im})
\]

where \(R_{im}\) is cropland cash rent for MLRA \(m\) in production region \(i\), \(b_i\) is the estimated coefficient applying to production region \(i\), and \(Y_{im}\) is yield index for cropland in MLRA \(m\) within production region \(i\). Each of the ten equations showed a direct and significant (at .99 confidence levels) regional relationship between cash rent and yield index, reflecting the importance of yield potential to expected net returns to land. \(R^2\) values ranged from 0.87 for the Northeast to 0.96 for the Northern Plains, and \(b_i\) values ranged from 0.296 for the Southern Plains to 0.66 for the Corn Belt.

The set of regional equations was used to assign cash rent estimates to each LRG in each state:

\[
R_{jki} = a_i(Y_{jki})
\]

where \(R_{jki}\) is cropland cash rent for LRG \(j\) in state \(k\) in production region \(i\); and \(Y_{jki}\) is the EPIC-generated yield index for LRG-state “bundle” \(jk\).

The bid level for each LRG-state bundle of cropland was expressed as a function of cash rent and the farmer’s average annual cost of establishing and maintaining vegetative cover on CRP acreage [see equation (5) in text]. Costs, by state, of establishing various grass and tree covers were obtained from the 1985 Agricultural Stabilization and Conservation Service (ASCS) Conservation Reporting and Evaluation System data file. A single cover establishment cost was calculated for each state by weighting the grass and tree costs by the proportion of tree covers indicated by May 1986 sign-ups for the CRP. Maintenance costs of 3% for grasses and 1% for trees were used. While the government pays half of the costs of establishment, the farmer participant is responsible for the total cost of maintenance.

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9 An LRG is a grouping of land resources by Land Capability Class/Subclass (LCC). Soil and Water Resource Conservation Act assessment efforts have identified and use 8 LRG designations to aggregate 19 LCC’s, as follows: LRG1 = LCC’s I, Iwa, and IIwa; LRG2 = LCC Ile; LRG3 = LCC IIle; LRG4 = LCC IVe; LRG5 = LCC’s IIc, IIlc, and IVc; LRG6 = LCC’s IIls, IIIls, IVls; LRG7 = IIt, IIIIt, and IVt; and LRG8 = LCC’s V, VI, VII, and VIII.

10 An MLRA is a geographically associated land resource unit within which physical and climatic conditions are relatively homogenous (USDA Soil Conserv. Serv., 1981).