Priorities in Cost Sharing for Soil and Water Conservation:

A Revealed Preference Study

by

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Government efforts to address agricultural nonpoint source pollution problems in the U.S. have relied primarily on two methods: (1) paid diversion of highly erodible land into conservation uses and (2) cost sharing the installation of conservation structures or establishment of management practices. Both have persisted in various forms since the first conservation programs were established in the 1930s. Both were originally established to address problems of lost farm productivity due to erosion, but have been adapted to encompass broader environmental quality concerns (Magleby et al.).

Since 1985, the Conservation Reserve Program (CRP) has been the principal vehicle for paid land diversion. As of 1999, the CRP contained 31.3 million acres, located mainly in the Plains and Mountain states and enrolled at an annual cost of about $1.6 billion. It is administered at the national level through the Farm Service Agency, which evaluates farmers' offers of land for rental contracts by comparing an index of environmental benefits constructed from information about the land offered with the rental payment proposed by the farmer.

Until 1996, cost sharing was provided at the federal level under several programs with differing goals and criteria. The largest was the Agricultural Conservation Program (ACP). Other programs included the Water Quality Incentives Program, the Colorado River Basin Salinity Control Program, the Emergency Conservation Program, the Forestry Incentives Program, the Great Plains Conservation Program, the Rural Clean Water Program, the Small Watershed Program, the Soil and Water Conservation Loan Program, and the Stewardship Incentive Program. In 1996, all federal cost sharing programs were consolidated into the Environmental Quality Incentive Program (EQIP).

The scope of cost sharing programs has been much more modest than that of land diversion, as indicated by the 1999 annual EQIP budget of $200 million.

In contrast to the CRP, cost share funding decisions are made largely at the local level. Moreover, funding decisions (including both whether to accept a project proposal and the amount of cost sharing to offer) are made not by USDA personnel but by county employees accountable to a body elected from (and by) county farm owners and operators. Delegation of spending authority to autonomous local bodies dates back to the introduction of cost sharing programs in the 1930s. One possible rationale for it is overcoming problems of hidden information: A farmer's neighbors presumably know a great deal more about what a proposed project might accomplish and about the size of payment needed to induce the farmer to undertake the project than federal employees living outside the area. Thus, delegating funding decisions to local farmers (with oversight) could minimize or eliminate payment of information rent. (Smith discusses hidden information in the context of the CRP.)

A number of studies on the CRP have questioned how successfully paid land diversion has been adapted to address broad environmental policy concerns. Simulations by Reichelderfer and Boggess suggest that early CRP signups were more consistent with a criterion of maximizing total acreage than the stated criteria of erosion control and supply management. Ribaudo's estimates of water quality benefits similarly suggest that the CRP could have effected greater environmental quality improvements by altering the regional distribution of enrollment. Babcock et al. examine the distribution of enrollments under alternative environmental quality criteria.

Cost sharing has not been subjected to similar evaluation. Yet one might expect there to be similar concerns about the appropriateness of project targeting. Cost share funds have historically been distributed to counties on a block grant basis. A local committee determines the distribution of funds in each county. Eligibility of practices and award criteria vary from county to county. A potential concern is that the priorities of the local committees that make funding decisions may not conform closely to environmental quality needs identified at the state or regional level. These committees might place greater priority on local environmental quality, for example, small streams passing through farms rather than major water bodies. Alternatively, they might give more priority to projects that augment farm productivity than to those that enhance environmental quality or favor projects proposed by farmers with greater local influence or political connections.

This paper investigates these possibilities using a revealed preference approach to estimate the implicit decision criteria used to allocate federal cost-sharing funds in Maryland during the fiscal years 1994 through 1996. A number of studies have employed this approach to study determinants of government agency decision making in cases such as highway construction (McFadden), pesticide regulation (Cropper et al.), water pollution standards (Magat et al.), and consumer product safety regulation (Thomas). Maryland is an interesting state for such an investigation because cost sharing plays an important role in efforts to improve water quality in the Chesapeake Bay. Agriculture is an important source of nutrient loadings into the Bay, accounting for an estimated one-third of total nitrogen loadings and two-fifths of total phosphorus loadings into the Bay (Chesapeake Bay Program). The Bay is a water body of major regional significance, but water quality in the Bay is not necessarily affected by projects aimed at local streams or those aimed at preserving or enhancing farm productivity. Thus, the potential exists for a mismatch between cost sharing priorities at the local and state/regional levels.

Administration of Federal Cost Sharing Programs

Federal cost sharing is administered through a complex set of arrangements involving farmers, county employees, and USDA agencies. This set of arrangements dates back to the 1930s. The roles of the entities involved are as follows.

Funding is provided through USDA's Farm Services Agency (FSA). Funding is allocated to states and counties based on historical appropriations. FSA also provides financial oversight, reviewing funding decisions *ex post* to ensure that the projects receiving funding meet statutory criteria and to monitor against malfeasance.

Cost sharing is voluntary. Farmers submit proposals that give project details and requested funding. USDA's Natural Resource Conservation Service (NRCS) and local soil conservation districts provide technical assistance in preparing these proposals. They also provide technical oversight: NRCS must certify that a proposed project is consistent with overall conservation goals and with the farmer's individual conservation plan in order to make the project eligible for further review. NRCS technicians also provide technical information about the project for review purposes.

County committees (CCs) consisting of (and elected by) farm owners and operators resident in the county are ultimately responsible for deciding which proposals to accept and how much funding to offer for each accepted project. CCs work with FSA, NRCS, and soil conservation district personnel to conduct needs assessments and set overall priorities. They also hire a county executive director (CED) to make day-to-day administrative decisions. While paid from federal funds, the CED is employed by and accountable to the CC.

The CED reviews project proposals, ranks them, and makes recommendations regarding funding levels. The CC has authority to make final decisions about allocating the county's cost sharing budget.

Additional oversight is provided by state technical committees (STCs), whose members are appointed by the federal executive branch. STCs, in conjunction with NCRS personnel, set state priorities and make program policy recommendations. They also hear appeals on CC funding decisions. FSA personnel in Washington oversee STC operations.

Local farmer control over project funding decisions creates the potential for a mismatch between the priorities of cost sharing program expressed at the federal level and those actually guiding implementation of the program. Several types of incongruity between federal and local priorities seem possible. First, CCs may prefer to fund projects that enhance farm profitability regardless of environmental quality considerations that provide the nominal rationale for the program. Second, CCs may give priority to projects proposed by politically influential farmers over those with greater environmental quality benefits. Third, CCs may prefer to fund projects that enhance environmental quality at the local level rather than addressing broader regional and national environmental quality concerns.

The county level funding decision process can be represented formally as follows (see Babcock et al. for a similar characterization of CRP decision making). Consider a single CC with an annual budget M that receives j = 1, …, N applications for cost sharing. Proposed project j has a vector of characteristics X_j, verified by the NRCS technician. If CC decisions are influenced by political considerations, the characteristics of the farmer proposed the project, Y_j, will be relevant as well. The benefits of overall cost share spending, as perceived by the CC, are a function of those characteristics, $B(X_j,Y_j)$. The project proposal also contains estimates of the cost of the project to the farmer and the amount of cost sharing funds requested. The CC must decide whether or not to fund the proposed project.[1] Let θ_j be an indicator variable having a value of one if the project is approved for funding and zero otherwise. Let S_j be the amount of cost sharing requested. The goal of the CC should be to maximize perceived benefits subject to a constraint on its budget.

Formally, the CC is assumed to choose $\theta = (\theta_1, \ldots, \theta_N)$ to

$$\max \sum_{j=1}^{N} \theta_j B(X_j, Y_j)$$
$$s.t. \quad \sum_{j=1}^{N} \theta_j S_j \le M.$$

In an optimum, the marginal value of cost share funds λ^* is chosen such that the net benefit of the marginal project m selected for funding is zero,

$$B(X_m, Y_m) - \lambda^* S_m = 0 . \qquad (1)$$

All projects with net benefits greater than those of the marginal project receive full funding ($\theta_j = 1$). The marginal project will receive full or partial funding ($\theta_m \le 1$), depending on the availability of funds. All projects with net benefits less than those of the marginal project will not be funded at all ($\theta_j = 0$).

This decision process suggests that the parameters of the CC's benefits function can be inferred from data on cost share requests, funding decisions, and project characteristics in the following manner. To a first order approximation, the benefits function for project j can be written:

$$B(X_j, Y_j) \approx b_0 + \sum_{k=1}^{K} b_k X_{kj} + \sum_{n=1}^{N} g_n Y_{nj} + e_j \ . \qquad (2)$$

Project j will be selected for funding if its perceived net benefit is positive:

$$b_0 + \sum_{k=1}^{K} b_k X_{kj} + \sum_{n=1}^{N} g_n Y_{nj} + e_j - l * S_j \geq 0 \, . \qquad (3)$$

The probability that the CC selects project j for funding is thus

$$\begin{aligned} \Pr\{q_j = 1\} &= \Pr\{h_j \leq b_0 + \sum_{k-1}^{K} b_k X_{kj} - l * S_j\} \\ &= F(b_0 + \sum_{k-1}^{K} b_k X_{kj} - l * S_j), \end{aligned} \qquad (5)$$

where $\eta_j = -[\sum_n \gamma_n Y_{nj} + \varepsilon_j]$ and $F(\eta)$ is the cumulative distribution of η. In what follows, we assume that the η_j are independently and identically distributed normally and estimate the parameters of the CC's benefits function $\beta_0, \ldots, \beta_K$ and λ^* using maximum likelihood probit. As is well known, the benefits function parameters are identified only up to a constant. Their signs are identified, however, permitting testing hypothesis about whether CCs place a positive, negative, or no weight on each attribute.

Data

The data for this research come from the Conservation Reporting and Evaluation System (CRES), a data bank constructed from the information collected by the technician assigned to analyze applications for cost share funding (U.S. Department of Agriculture). Beginning in 1995, CRES also included information on all applications including those that did not receive funding. Files for the State of Maryland for 1995 and 1996 were obtained via a request under the Freedom of Information Act. Duplicate data from applications that remained active over more than one year were removed from the data set.

The CRES database contains 190 variables that fall into four broad categories: referral information, background information, practice specific information, and administrative tracking information. Of these 190 variables, only those discussed below were relevant to potential CC decision criteria for projects in Maryland. The remainder consisted of administrative details or pertained to types of projects not undertaken by Maryland farmers (e.g., rangeland management).

Referral information contains identification for each farmer (name, ID, address, etc.) and a brief description of the conservation practice to be installed.

Background information includes the primary purpose of the practice, the source of funds, the program code, the estimated total cost of the project, the cost-share requested, and the number of acres served by the practice. It also includes site characteristics such as land capability class, soil loss tolerance, land cover and use both before and after project installation, types of endangered species protected, and the hydrologic unit in which the project was located.

Practice-specific information was provided by the NRCS technician helping prepare the project proposal. It varies according to the primary purpose of the proposed project. Examples of information recorded for projects whose primary purpose is water quality include the type of water quality problem addressed, water body treated, and the severity of water pollution in the affected water body. Information recorded for projects whose primary purpose is erosion control include acreage served by erosion control measures and tons of soil saved from sheet, rill, wind and other types of erosion. Information recorded for projects whose primary purpose is forestry include the condition of forest cover before and (expected) after the project, potential tree productivity, the number of trees per acre, and the tree species involved in the project. Other types of information were recorded for projects whose primary purpose was water storage, irrigation, or rangeland management. Maryland had few projects with these primary purposes. Some projects had multiple purposes. The relevant information was reported according to the secondary purpose of the project as well. Project attributes for which information was not recorded (because the project did not have the relevant primary or secondary purpose) were assigned a value of zero, making the variables equivalent to an interaction term between the project attribute and a dummy variable for the relevant primary or secondary purpose.

Included in the administrative tracking information were the dates on which the project was either approved or denied funding. These dates were used to construct a binary indicator taking on a value of one if the data included a date on which the project was approved for funding and zero if the data included a date on which the project was denied funding. For projects awarded funding, the CRES data include information about the actual installation cost of the project, the cost-share actually offered, and the date the project was completed.

During fiscal years 1994 through 1996, 4,902 proposals were submitted for cost sharing under seven different programs (Table 1). Each county had separate budgets for each of these seven programs, suggesting that each CC faced seven different budget constraints. The ACP was by far the largest source of cost-sharing assistance, accounting for 80% of the applications. To be consistent with the decision model, we included in the analysis only applications for cost-share assistance under the ACP. The goals of the ACP are to encourage reductions in soil loss and agricultural contributions to water pollution from both runoff and direct discharge in ways that provide long-term and community-wide benefits. Eligible practices and criteria vary from county to county.

Applications for cost sharing with ACP funds were made for twenty-four different types of conservation practices during this period. Almost one-third of the project proposals submitted had water quality as the primary purpose (Table 2). Most of the remainder had water quality as a secondary purpose. A large proportion of project applications were awarded funding (Table 3), possibly due to the stringency of prior screening by NRCS technicians.

Model Specification and Estimation

The goals of ACP cost sharing include protecting farm productivity and enhancing environmental quality. The CRES data include project characteristics associated with both goals. The following variables were used to measure project attributes relevant to the cost share funding decision (X_1, …, X_J). Table 4 summarizes our hypotheses regarding the interpretation of their coefficients. Complete sets of observations on these variables were available for a total of 2,271 project applications. Table 5 gives descriptive statistics.

Characteristics Recorded for All Projects

Primary Purpose of Project

We distinguished four types of primary purposes: erosion control, water quality, wood production, and other purposes. Dummy variables were created for each one. As noted above, water quality problems have been the principal environmental concern associated with agriculture in Maryland. If CCs emphasize environmental quality, they should be more likely to award funds to projects addressing water quality problems.

Farm Productivity

Potential farm productivity effects were measured by two types of variables: current land use and land quality. CRES records the type of land cover before the project and that expected after project installation. A dummy variable was created to distinguish cropland (grain and non-grain crops) from non-cropland uses (pasture, rangeland, forest, and other land uses). Land quality was reported using the NRCS land capability classification system. We grouped the eight NRCS land capability classes into three categorical variables. High quality land (classes I and II) is the most productive and can be used for most, if not all, purposes. The productivity of medium quality land (classes III and IV) is limited in some uses. The productivity of low quality land (classes V and higher) is sufficient for only a restricted number of uses. If CCs emphasize protection of cropland, they should be more likely to award funding to projects on land of higher quality and/or land currently planted to crops.

Project Cost

The amount of cost sharing requested was reported for all projects. Equation (4) indicates the coefficient of the amount of cost share requested S_j should equal the marginal value of funds due to the budget constraint, λ^*. If CCs are constrained by their budgets from funding all projects generating positive net benefits, this coefficient should be negative. If CCs are not constrained by their budgets, this coefficient should be zero. A positive coefficient could arise for a number of reasons. It could be due to CCs allocating funds to projects generating negative net benefits in order to protect future budget allocations by spending all current funds. Alternatively, a positive coefficient on cost could be attributable to a positive correlation between the cost share requested and the political influence of the farmer proposing the project.[2]

Erodibility

Erodibility, and thus potential damage to farmland and the environment from erosion, was measured by the soil loss tolerance, defined as the maximum annual soil loss that could be incurred while maintaining a high level of crop productivity. The soil loss tolerance of the land on which the project would be installed was reported in discrete values ranging from 1 to 5 tons of soil loss per acre per year. The soil loss tolerance was used to create four dummy variables in order to permit nonlinearity in the perceived value of erodibility. If CCs emphasize reductions in sedimentation and off-farm problems associated with erosion, they should be more likely to award funding to projects on land more vulnerable to erosion, that is, land with lower soil loss tolerances. If they emphasize maintenance of farm productivity, they should be more likely to award funding to projects on land that is less vulnerable to erosion since this latter type is most commonly used for crop production.

Information Recorded for Projects with Specific Primary or Secondary Purposes

Information on the remaining project attributes was collected mainly for projects with certain primary or secondary purposes. The coefficients of these variables in the model thus have a conditional interpretation: They represent the weight accorded to the project characteristic in the benefits function given that the project has the relevant primary or secondary purpose. In other words, each variable is equivalent to the product of the characteristic and a dummy variable that equals one if a project has a specific primary or secondary purpose and zero otherwise.

<u>Characteristics of Projects with Water Quality as a Primary or Secondary Purpose</u>

The types of water quality problems addressed by the proposed project included sediment, agricultural/animal waste, nutrients from inorganic fertilizers, pesticides and toxic substances, and others. We created a categorical variable for each of these five types of water quality problem. As noted earlier, the principal water quality problems related to agriculture statewide involve nutrients from fertilizers and animal wastes, although herbicides in streams and well water have evoked some concern. If CCs emphasize water quality problems, they should be more likely to grant funding to projects targeting fertilizers and animal wastes and, at least to some extent, pesticides.

The data distinguished five types of water bodies affected by the proposed project: rivers, lakes, groundwater, wetlands, and estuaries. We created a categorical variable for each type of water body affected. The Chesapeake Bay, the principal water body of concern statewide, is the only estuary in the state. If CCs emphasize Bay water quality, they should be more likely to fund projects targeting estuaries. Emphasis on groundwater should indicate priority granted to local environmental concerns, since the water bearing formations used differ across (and sometimes within) counties. Emphasis on rivers could indicate granting priority to either local or regional environmental concerns, since the category includes major rivers that are of regional importance either by themselves (e.g., the Potomac) or as Bay tributaries in addition to small streams of strictly local interest. Emphasis on wetland could similarly indicate granting priority to either local or regional environmental concerns: Wetlands are local resources but a source of general concern in the region.

CRES included categorical measures of the current status of water quality in the water body affected by the proposed project. Water quality status was recorded in terms of the Environmental Protection Agency's categorization as to whether designated uses of that water body were impaired, threatened, met or not determined. We created a dummy variable for each of these water quality status categories. In many cases the designated use of the water body had not been determined. We hypothesize that the latter consist primarily of small streams, local groundwater, ponds, etc. This interpretation suggests that a positive coefficient on this variable indicates that the CC gives special emphasis to local-level water quality problems.

Characteristics of Projects with Soil Erosion as a Primary or Secondary Purpose

Information collected for projects whose primary purpose was soil erosion included tons of soil saved, type of erosion, and acreage on which erosion would be reduced. Each was recorded for every practice included in the project proposal. The amount of soil saved from erosion and the acreage on which erosion was reduced were both aggregated across all of the practices included in the proposal to get overall project totals. If CCs emphasize erosion control, they should be more likely to award funding to projects with greater reductions in erosion and those controlling erosion on larger acreage. A positive coefficient on the acreage receiving erosion control could also arise from a positive correlation between project size and farm size if larger farmers propose larger projects and exert greater political influence.

Characteristics of Projects with Forestry as a Primary or Secondary Purpose

Information collected for projects whose primary purpose was wood production included an index of the potential of the project site for timber production. A higher value of this index indicates greater potential timber productivity If CCs emphasize productivity (and thus farm income), they should be more likely to grant funding to projects on sites with greater timber production potential.

Testing for Differences in CC Preferences Across Counties

Each CC receives a separate budget, suggesting that its decisions should be modeled separately. Nevertheless, aggregation is desirable in order to increase the number of observations used to estimate the parameters of each benefits function. We tested for differences in benefits function parameters across counties by including county-specific dummies in the model, both by themselves and interacted with every other variable. A large number of the interaction terms were collinear, for several reasons. In some cases, collinearity was due to the fact that in some counties the number of project attributes exceeded the number of projects with a given primary purpose. In other cases, all of the projects in a county with a given primary purpose had many of the same attributes. In still other cases, none of the projects in a county with a given primary purpose had certain attributes. These collinear and zero-value variables were omitted from the model. Wald tests were then used to ascertain whether all of the interaction terms were simultaneously equal to zero. The hypothesis of no difference across CCs could not be rejected at the 5 percent significance level for every variable.[3] All of the interaction terms were thus dropped.

Estimation Results

Table 7 presents the estimated coefficients of the probit model. The model fits the data reasonably well, as indicated by a McFadden R^2 of 0.20 and the fact that the hypothesis that all of the coefficients equal zero is rejected at any reasonable significance level.

As noted earlier, local control over project funding decisions creates the potential for cost sharing funds to be allocated in ways that do not meet broader environmental quality goals at the state, regional, and federal levels. Local committees may fund projects that enhance farm profitability may be funded regardless of environmental quality considerations. They may fund projects proposed by politically influential farmers with lower environmental quality benefits than those proposed by others. They may fund projects that enhance environmental quality at the local level rather than addressing broader regional and national environmental quality concerns. Overall, the estimated coefficients of the probit model suggest that productivity considerations play a major role in cost share funding decisions. They do not provide evidence, however, that these funding decisions ignore environmental quality criteria or give undue priority to larger, presumably more influential farmers.

The signs and significance of several coefficients suggest that CCs strongly favor projects that enhance farm productivity. Projects involving cropland were more likely to be awarded funding, as were projects affecting high or medium quality land. Forestry projects with greater site productivity potential were also more likely to be awarded funding. The fact that the coefficient of land with the highest soil loss tolerance (lowest vulnerability to erosion) was significantly different from zero and positive (while the remaining soil loss tolerance variables were not significantly different from zero) is also consistent with an emphasis on enhancing farm productivity: In Maryland, more erodible land is generally less productive and thus less likely to be cropped.

The estimated parameters suggest that CCs continue to give priority to erosion control, the classical mission of cost sharing. Projects whose primary purpose was soil erosion were significantly more likely to be awarded funding. The coefficient of total soil savings was positive and significantly different from zero as well, indicating that CCs accord greater priority to projects expected to achieve greater levels of erosion control.

The picture with respect to water quality is mixed. The dummy for water quality as a primary purpose was omitted from the model. Thus, priority for projects with water quality as a primary purpose would be indicated by negative coefficients on the dummies for the remaining primary purposes. But the dummies for the primary purposes of (a) soil erosion and (b) other purposes had coefficients that were positive and significantly different from zero at the 5 percent level, indicating that projects whose primary purpose was water quality were less likely to be awarded funding than those targeting primarily erosion control or other purposes.

However, projects aimed at reducing nutrient runoff from inorganic fertilizers and animal waste were each significantly more likely to receive funding, as were projects aimed at pesticides and toxics. (The dummy for other types of water quality problems was omitted from the model.) Projects aimed at sedimentation, by contrast, were not significantly more likely to be awarded funding. Thus, CCs appear to have given priority to nutrient and pesticide runoff reduction projects, that is, to projects aimed at the principal types of water quality problems emanating from agriculture in Maryland.

With respect to the type of water body affected, the coefficients of rivers, lakes, and groundwater were not significantly different from zero at the 5 percent level. Since the variable for estuaries was omitted from the model, these results indicate that CCs do not give greater priority to projects aimed at the Chesapeake Bay than to projects aimed at these other water bodies. Projects involving wetlands are generally undertaken to improve wildfowl habitat and thus income from renting farmland for goose and duck hunting. Thus, the positive coefficient of the wetlands variable likely indicates priority given to projects that enhance farm income.

With respect to water quality status, projects affecting water bodies whose designated use was impaired, threatened, or not determined were significantly more likely to receive funding than those affecting water bodies whose designated use had been met (which was omitted from the model). The positive signs of the coefficients of the variables indicating impaired or threatened designated use imply that CCs target recognize water quality problems. As noted earlier, according priority to water bodies whose use has not been determined can be interpreted as a concern with water quality at the local level.

Overall, the results suggest that CCs are selective about projects claiming water quality benefits. They appear to give priority to projects aimed at water quality problems attributable to agriculture (that is, those involving fertilizers, animal wastes, and pesticides) and to projects affecting water bodies where water quality is a greater concern (those where the designated is impaired or threatened). They do not appear to give priority to projects aimed at the Chesapeake Bay, the principal water body of concern at the state and regional levels, although projects aimed at other water bodies may affect the Bay indirectly.

CCs in Maryland also appear to be selective in funding projects whose primary purpose was forestry. The coefficient of forestry as a primary purpose was not significantly different from zero. The coefficient of timber site index was positive and significantly different from zero, however, indicating that the projects on more productive timber sites are more likely to receive cost share funding.

The coefficients of the cost share requested is positive and significantly different from zero, indicating that CCs face binding budget constraints in choosing among projects with positive net benefits.

Taken together, the negative coefficient of the cost share requested variable and the fact that the coefficient of total acreage receiving erosion control was not significantly different from zero suggest that political considerations have not played a systematic role in CC cost sharing allocation decisions in Maryland. As noted earlier, it is commonly believed that larger farmers wield greater political influence. They are also more likely to propose larger-scale, more costly projects. The results obtained here do not indicate a positive correlation between project size and cost and the likelihood of receiving cost share funding.

Conclusion

Cost sharing of soil and water conservation practices and paid diversion of agricultural land have been the two principal policy instruments used to address problems associated with nutrient runoff and sedimentation from agricultural sources. Both have been adapted from programs originally introduced in the 1930s to protect farm productivity.

The work of Reichelderfer and Boggess and of Ribaudo raised questions about the success with which paid land diversion (in the form of the CRP) has been adapted to accommodate broader environmental concerns. The results of our investigation suggest cost sharing in Maryland has been directed toward recognized environmental quality problems that can be addressed by projects that enhance farm productivity and profitability. Projects that promise to increase farm productivity and income are more likely to be allocated cost share funding, as are projects that affect water bodies whose designated use is impaired or threatened. Projects involving animal wastes, inorganic nutrients, and pesticides—the major agricultural sources of water quality problems in

Maryland—are more likely to be funded. In sum, in contrast to findings regarding the CRP, our results do not indicate that cost share awards in Maryland have been inconsistent with stated environmental quality priorities.

Our data did not include measures of changes in environmental quality or direct measures of the political influence of individual farmers. We were thus unable to examine the extent to which cost sharing was effective in improving environmental quality in Maryland or the efficiency of cost share funding allocations in meeting environmental quality goals. Some of our results appear to be inconsistent with the hypothesis that more influential farmers are more likely to be awarded cost share funding. However, this interpretation depends on assumed positive correlations between political influence, project size, and project costs, assumptions that could not be examined formally using our data. Thus, further research based on different data is needed to address these issues.

Footnotes

[1] It might be argued that CCs have the power to choose the amount of cost sharing to award as well as whether to fund a project. Farmers proposing projects they expect to generate positive net returns should be willing to accept less than the full cost share funding to which they are legally entitled and CC members' intimate knowledge of local conditions and their fellow farmers may enable them to estimate the minimum cost share needed to induce participation. In fact, one rationale for making cost share funding decisions at the local level is that farmers have better information about the true costs and benefits of conservation projects, so that delegating spending authority to the local level reduces or eliminates hidden information about the likely costs of proposed projects and thus reduces or eliminates the payment of information rents. At the same time, social and political considerations likely militate against attempts by CC members to induce their neighbors to accept payments that are less than those to which they are legally entitled, since such attempts could create tensions within the farm community as well as reducing CC members' reelection prospects. As a practical matter, Maryland CCs do not appear to have chosen to adjust cost share payments much, if at all, during this period. For example, we regressed the cost share offered on the cost share requested for the subsample of the data for which cost share awards had been made. The coefficient of the cost share requested was 0.93 with a standard error of 0.009, the constant term was not significantly different from zero, and the regression R^2 was 0.89, suggesting that CC cost share offers almost exactly equaled the cost share requested.

[2] In principle, a negative coefficient could arise from a negative correlation between the amount of cost sharing requested and the political influence of farmers' proposing projects. However, larger farmers tend to have greater influence and are more likely to propose larger projects as well, making a positive correlation between political influence and cost sharing requested more likely than a negative one.

[3] The Wald statistics for the tests of whether the county-dummy interaction terms were simultaneously equal to zero for each variable were: Constant term (8.4446, 22 degrees of freedom), estimated cost share (17.5134, 22 degrees of freedom), primary purpose erosion control (8.0092, 21 degrees of freedom), primary purpose wood production (2.6868, 15 degrees of freedom), primary purpose other assistance (0.4578, 9 degrees of freedom), cropland (15.1384, 21 degrees of freedom), land capability class I or II (16.5857, 22 degrees of freedom), land capability class III or IV (9.3826, 20 degrees of freedom), site potential index (6.5925, 14 degrees of freedom), total soil saved (27.5635, 19 degrees of freedom), total acreage with erosion control (23.9388, 19 degrees of freedom), soil loss tolerance 2 tons per acre per year (6.3779, 8 degrees of freedom), soil loss tolerance 3 tons per acre per year (9.7466, 17 degrees of freedom), soil loss tolerance 4 tons per acre per year (9.6947, 19 degrees of freedom), soil loss tolerance 5 tons per acre per year (8.2880, 14 degrees of freedom), project involves sediment (2.3094, 15 degrees of freedom), project involves animal waste (3.0649, 21 degrees of freedom), project involves inorganic nutrients (1.7764, 11 degrees of freedom), project involves pesticides or toxics (1.7386, 6 degrees of freedom), type of water body affected: rivers (3.2766, 15 degrees of freedom), type of water body affected: lakes (1.9887, 6 degrees of

freedom), type of water body affected: wetlands (1.9851, 9 degrees of freedom), type of water body affected: groundwater (1.7814, 5 degrees of freedom), designated use impaired (0.0477, 2 degrees of freedom), designated use threatened (2.1976, 12 degrees of freedom), designated use not determined (1.0761, 8 degrees of freedom).

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Table 1. Applications for Cost Sharing in Maryland by Conservation Program, Fiscal Years 1994-1996.

Name	Purpose	Agency	Limitations	Number of Applications
Agricultural Conservation Program (ACP)	Prevent soil loss and water pollution	FSA	Up to 75% of the cost of installation, with a maximum of $3,500 per person per year.	3875
Conservation Reserve Program (CRP)	Retire land from production and establish 10-year conservation cover	FSA	Up to 50% of the cost to establish cover.	109
Emergency Conservation Program (ECPF)	Repair agricultural land damaged by natural disasters and conserve water during droughts	FSA	Up to 64% of the first $62.5k, 40% of the second $62.5k, and 20% of the eligible costs above $125k; payment limit of $200k per person, per disaster.	83
Forestry Incentive Program (FIP)	Plant trees and improve timber stands	NRCS	Up to 65% of the cost of the activity, not to exceed $10k per person per year.	106
Rural Clean Water Program (RCWP)	Control agricultural non point source water pollution in rural areas	NRCS	Up to 75% of the total cost of the activity, and up to $50k per person for the life of the program.	58
Stewardship Incentive Program (SIP)	Manage non industrial private forest land to increase timber supply and improve fish and wildlife habitat and recreation	Forest Service	Up to 75% of the cost of installation, with a maximum of $10k per person per year.	661
Tree Assistance Program (TAP)	N/A	N/A	N/A	10
Total				4902

Source: U.S. General Accounting Office, CRES data.

Table 2. Applications for Cost Share Assistance Under ACP by Primary Purpose and Practice.

Conservation Practices	Code	Primary Purpose	Share (%)
Integrated crop management	SP53	WQ	26.7
Sod waterways	WP3	EC/WQ	14.4
Permanent vegetative cover establishment	SL1	EC/WQ	13.9
Grazing Land Protection	SL6	EC/WQ	7.8
Forest Tree Plantations	FR1	EC/WP	6.7
Agricultural Waste Control Facilities	WP4	WQ	5.7
Erosion or water control structures	WP1	EC/WQ	4.4
Forest Tree Stand Improvements	FR2	EC/WP	3.9
Permanent vegetative cover in critical areas	SL11	EC/WQ	2.9
Stream Protection	WP2	EC/WQ	2.7
Permanent vegetative cover improvement	SL2	EC/WQ	2.1
Others			8.8
Total			100.0

Note: WQ - water quality; EC - erosion control; WP - wood production.
Source: CRES data.

Table 3. Approval Rates for Cost Sharing by County

County	Not Approved	Approved	Total	Approval Rate (%)
Allegany	78	72	150	48
Anne Arundel	9	20	29	69
Baltimore	20	51	71	72
Calvert	4	13	17	76
Caroline	12	23	35	66
Carroll	64	126	190	66
Cecil	65	218	283	77
Charles	4	22	26	85
Dorchester	7	59	66	89
Frederick	101	188	289	65
Garrett	25	40	65	62
Harford	19	36	55	65
Howard	16	46	62	74
Kent	17	73	90	81
Montgomery	16	32	48	67
Prince Georges	1	8	9	89
Queen Anne’s	14	69	83	83
Somerset	48	64	112	57
St Mary’s	3	32	35	91
Talbot	10	42	52	81
Washington	36	65	101	64
Wicomico	92	191	283	67
Worcester	23	97	120	81
Total	684	1587	2271	70

Source: CRES data.

Table 4. Summary of Hypotheses Regarding Interpretation of Coefficients

Variable	Sign of Coefficient if County Committee Values:			
	Farm Produc-tivity	Erosion Control	Local Environ-mental Quality	Regional Environ-mental Quality
Primary purpose erosion control	+	+	?	?
Primary purpose wood production	+	?	?	?
Primary purpose other assistance	+	0	0	0
Cropland	+	?	?	?
Land capability class I or II	+	?	?	?
Land capability class III or IV	+	?	?	?
Variables Recorded for Projects with Forestry as a Primary or Secondary Purpose[a]				
Site index	+	?	?	?
Variables Recorded for Projects with Soil Erosion as a Primary or Secondary Purpose[b]				
Total soil saved (tons)	+	+	?	?
Total acreage with erosion control (1000 acres)	+	+	?	?
Soil loss tolerance 2 tons per acre per year	?	-	-	-
Soil loss tolerance 3 tons per acre per year	?	-	-	-
Soil loss tolerance 4 tons per acre per year	+	-	-	-
Soil loss tolerance 5 tons per acre per year	+	-	-	-
Variables Recorded for Projects with Water Quality as a Primary or Secondary Purpose[c]				
Project involves sediment	0	+	+	?
Project involves animal waste	0	0	+	+
Project involves inorganic nutrients	0	0	+	+
Project involves pesticides or toxics	0	0	+	?
Type of water body affected: rivers	0	0	+	?
Type of water body affected: lakes	0	0	+	-
Type of water body affected: wetlands	0	0	+	?
Type of water body affected: groundwater	0	0	+	-
Designated use impaired	0	0	?	+
Designated use threatened	0	0	?	+
Designated use not determined	0	0	+	0

[a] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if forestry is the primary or secondary purpose and zero otherwise.
[b] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if soil erosion is the primary or secondary purpose and zero otherwise.

[c] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if water quality is the primary or secondary purpose and zero otherwise.

Table 5. Descriptive Statistics of the Variables Used in the Probit Model.

	Mean	Standard Deviation
Number of Observations	2271	
Approved Projects	1587	
Approval Rate (%)	70	
Estimated cost share ($1000)	1.52	1.37
Primary purpose erosion control	0.39	0.49
Primary purpose water quality	0.47	0.50
Primary purpose wood production	0.10	0.31
Primary purpose other assistance	0.04	0.19
Cropland	0.36	0.48
Land capability class I or II	0.26	0.44
Land capability class III or IV	0.34	0.47
Land capability class V or higher	0.06	0.23
Variables Recorded for Projects with Forestry as a Primary or Secondary Purpose[a]		
Site index	7.7926	24.07
Variables Recorded for Projects with Soil Erosion as a Primary or Secondary Purpose[b]		
Total soil saved (tons)	14.98	52.04
Total acreage with erosion control (1000 acres)	0.04	0.13
Soil loss tolerance 1 ton per acre per year	0.04	0.19
Soil loss tolerance 2 tons per acre per year	0.05	0.21
Soil loss tolerance 3 tons per acre per year	0.27	0.44
Soil loss tolerance 4 tons per acre per year	0.18	0.39
Soil loss tolerance 5 tons per acre per year	0.12	0.32
Variables Recorded for Projects with Water Quality as a Primary or Secondary Purpose[c]		
Project involves sediment	0.13	0.33
Project involves animal waste	0.22	0.41
Project involves inorganic nutrients	0.13	0.34
Project involves pesticides or toxics	0.04	0.20
Project involves other problems	0.01	0.11
Type of water body affected: rivers	0.39	0.49
Type of water body affected: lakes	0.01	0.10
Type of water body affected: wetlands	0.03	0.17
Type of water body affected: estuary	0.06	0.24
Type of water body affected: groundwater	0.04	0.19
Designated use impaired	0.01	0.10
Designated use threatened	0.19	0.39
Designated use not determined	0.33	0.47
Designated use met	0.004	0.06

[a] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if forestry is the primary or secondary purpose and zero otherwise.

[b] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if soil erosion is the primary or secondary purpose and zero otherwise.
[c] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if water quality is the primary or secondary purpose and zero otherwise.

Table 6. Coefficients of the Cost Share Funding Approval Model

	Coefficient	Standard Error
Constant term	-1.11**	0.13
Estimated cost share ($1000)	-0.08**	0.03
Primary purpose erosion control	0.58**	0.13
Primary purpose wood production	0.18	0.33
Primary purpose other assistance	0.69**	0.19
Cropland	0.45**	0.10
Land capability class I or II	0.33**	0.13
Land capability class III or IV	0.40**	0.12
Variables Recorded for Projects with Forestry as a Primary or Secondary Purpose[a]		
Site index	0.02**	0.004
Variables Recorded for Projects with Soil Erosion as a Primary or Secondary Purpose[b]		
Total soil saved (tons)	0.003**	0.001
Total acreage with erosion control (1000 acres)	0.26	0.24
Soil loss tolerance 2 tons per acre per year	0.12	0.18
Soil loss tolerance 3 tons per acre per year	0.08	0.13
Soil loss tolerance 4 tons per acre per year	0.24	0.15
Soil loss tolerance 5 tons per acre per year	0.36*	0.15
Variables Recorded for Projects with Water Quality as a Primary or Secondary Purpose[c]		
Project involves sediment	-0.41	0.26
Project involves animal waste	0.99**	0.25
Project involves inorganic nutrients	0.81**	0.26
Project involves pesticides or toxics	1.60**	0.31
Type of water body affected: rivers	0.02	0.15
Type of water body affected: lakes	5.70	759.1
Type of water body affected: wetlands	0.85**	0.30
Type of water body affected: groundwater	-0.17	0.22
Designated use impaired	0.77*	0.40
Designated use threatened	0.61*	0.26
Designated use not determined	1.04**	0.27
χ^2 statistic for all variables except constant = 0, 400 degrees of freedom	1458.548	
McFadden R^2	0.20	

** Significantly different from zero at the 1 percent level.

* Significantly different from zero at the 5 percent level.

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[b] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if soil erosion is the primary or secondary purpose and zero otherwise.

[c] Variable is equivalent to an interaction term between the indicated variable and a dummy equaling one if water quality is the primary or secondary purpose and zero otherwise.