

tial land use planning response.

The actual policies which are adopted in response to concerns about livestock manure will likely vary across the country, reflecting different attitudes towards agriculture and livestock. These attitudinal differences exist between different communities and also exist between individuals within a community. These differences reflect the nature and extent of the livestock industry, the role of agriculture within the local economy, the relative presence of non-farm development, the community's recent experience with agriculture, and the relative health of the local environment. Although it is difficult to address issues of management or respond to an existing situation, land use planning can be used as a tool to guide the continued development of the livestock industry.

The policy response suggested within this paper is not intended as a recipe for the future, but rather as a smorgasbord of options that individual jurisdictions may review and select from according to local or regional circumstances. While some of the approaches may not be possible under existing provincial or state legislation, it is anticipated that upper levels of government will also be searching for tools to respond to potential conflicts between the livestock industry, the environment and the rural community. This paper has been developed from the perspective that while policy or legislation may need to be developed by upper levels of government, the actual implementation is best achieved at the local level. This suggests that the relationship between the province and municipality as it relates to this issue will also be a topic of discussion that will need to evolve.

While it is hoped that public consultation, community dialogue, and an agriculturally supportive planning process will reduce the need for a regulatory approach, it is anticipated that regulation will be significant in the future siting of intensive livestock facilities. While some might argue that a regulatory approach is passé, the alternative of "do little or nothing" is even more unacceptable. No, the reality of the political process will be increasing public involvement in the siting of livestock facilities. In this process there is much to be lost or much to be gained. At one extreme, the relationship between the livestock industry and community deteriorates to one of acrimony, harassment and lawsuits, with the eventual loss of the livestock industry from a given community. At the other extreme, communities and the livestock sector have the opportunity

to work together to develop an approach that is fair and equitable, resulting in a vibrant livestock industry that is able to make a positive contribution to the community.

REFERENCES CITED

- Caldwell, W. J. 1995. Setting: a municipal council meeting, somewhere in rural Ontario - agenda: land use planning and siting livestock and poultry facilities. In J.A. Munroe (ed.) Siting Livestock and Poultry Operations for the 21st Century. Canadian Agri-Food Research Council, Ottawa.
- Dobson, G. 1995. Animal Waste Inspections of 1995. Division of Environmental Management, Fayetteville.
- Daniels, T.L. 1991. The purchase of development rights. *Journal of the American Planning Association*. 57: 421-431.
- Harvey, L., and L. Lohr. 1992. Regulations and laws affecting livestock facilities. Paper presented at the 1992 International Winter Meeting of the American Society of Agricultural Engineers, Nashville Tennessee.
- Korevaar, H. 1995. Impact of intensive livestock & poultry farms on the environment - European experience. In J.A. Munroe (ed.) Siting Livestock and Poultry Operations for the 21st Century. Canadian Agri-Food Research Council, Ottawa.
- Manale, A. 1995. Livestock industry structure and environmental quality in the United States. In J.A. Munroe (ed.) Siting Livestock and Poultry Operations for the 21st Century. Canadian Agri-Food Research Council, Ottawa.
- Manitoba Agriculture. 1995. Farm Practice Guidelines for Hog Producers in Manitoba. Manitoba Agriculture, Winnipeg.
- Penfold, G., J. Mathews, D. Flaming, and D. Brown. 1989. Right to farm in Canada. *Plan Canada* 29: 47-55.
- Ritter, W. F. 1989. Odour control of livestock wastes: state-of-the-art in North America. *Journal of Agricultural Engineering Research* 42: 51-62.
- Robson, B. 1995. Siting livestock and poultry operations - Canadian perspective. In J.A. Munroe (ed.) Siting Livestock and Poultry Operations for the 21st Century. Canadian Agri-Food Research Council, Ottawa.
- Satchell, M. 1995. Hog heaven - and hell. U.S. News and World Report. January 22. Surgeoner, G.A. and J.D. Dalrymple. 1995. Improving efficiencies in Ontario pork production. *Agri-Food Research in Ontario, Special Issue*, July: 24-28.
- Toombs, M.R. 1996. Cultivating farm, neighbour and community relations. In *Animal Agriculture and the Environment. Proceedings from the Animal Agriculture and the Environment North American Conference*, Ithaca, New York.

Early experience with Pennsylvania's agricultural conservation easement program

Leigh J. Maynard, Timothy W. Kelsey, Stanford M. Lembeck, and John C. Becker

Interpretive summary

Numerous public programs exist to protect farmland from commercial and residential development. One of these is Pennsylvania's agricultural conservation easement program, which allows farmland owners to sell the rights to develop their land without giving up their other property rights. In its first three years, the program acquired the right to prevent development on over 24, 000 acres at a cost of over \$50 million. To justify the high cost, the program must demonstrate that it not only prevents development, but truly helps maintain farming

Key words: conservation easements, farmland preservation, purchase of development rights, rural-urban interface.

ABSTRACT: Purchase of conservation easements is becoming an increasingly common agricultural land preservation technique. This paper uses a survey of participants in Pennsylvania's agricultural conservation easement program to investigate the characteristics and attitudes of the initial easement sellers during the program's first three years. Demand for the program was found to be sensitive to development pressure. Participants were older on average than nonparticipating farmers. Debt reduction was the largest use of easement sale

proceeds, followed by savings and farm capital purchases. Implications for current policy decision making and future evaluation of the program's effectiveness are discussed.

The authors are, respectively, graduate research assistant, associate professor, professor, and professor in the Department of Agricultural Economics and Rural Sociology, The Pennsylvania State University, 106 Arnsby Building, University Park, PA 16802.

J. Soil and Water Cons. 53(2) 106-112

The appropriate methods to preserve agricultural land are subject to ongoing debate. One agricultural land preservation technique that is becoming increasingly common is the purchase of conservation easements (also known as Purchase of Development Rights).¹ In a purchased conservation easement program, owners voluntarily sell the right to prevent development on their farmland in exchange for a cash payment. The easement is held in perpetuity by an authorized government agency or nonprofit organization, and participation does not affect landowners' ability to continue using their land for agricultural purposes. The farm may be sold at any time or passed to heirs. The goal of agricultural conservation easement programs is to preserve enough farmland in sufficient concentration to support agricultural infrastructure and boost expectations that agricultural investments are justified (Daniels 1991).

This article documents the early experience of Pennsylvania's Agricultural Conservation Easement Program, broadening the body of evidence on participant characteristics and the short-run impacts of purchased conservation easement programs. Pennsylvania implemented a statewide agricultural conservation easement program in late 1989. This paper examines the reasons farmers participated in the program, determinants of easement purchase prices, the use of proceeds from the sale of conservation easements, and how the type and level of farming activity changed following an easement sale. The long-run impacts of Pennsylvania's conservation easement program will not be known for some time, but funding and administrative decisions must be made in the meantime. The issues addressed in this study are important to understand because they will help determine whether the easements truly maintain farming, or simply end up preserving open space.

Background

Farmland preservation receives strong public support in Pennsylvania (Lembeck et al. 1991). Among agricultural preservation techniques, conservation easements can have the advantage of permanence. Conservation easements offer farmers a middle ground between selling out to developers and zoning, which does not pay

compensation to those who are regulated. Furthermore, zoning is increasingly vulnerable to challenges that it violates constitutional protection against the taking of private property (Daniels 1991). Farmers may also receive property and estate tax benefits from an easement sale (Mittleman et al. 1985).

Buying conservation easements is costly, which is its major disadvantage as a farmland preservation technique. In areas of heavy development pressure, the cost of development rights may comprise the majority of the property's value (Lapping et al. 1989). Conservation easement programs also entail high operating and transaction costs (Derr 1988).

Geisler (1993) questions the efficacy of purchasing development rights as the domestic importance of land-based occupations continues to decline. Such programs are voluntary and do not guarantee that viable farms in high cost areas can be retained at reasonable cost. As the easement holder cannot require that a parcel be farmed, the danger arises that the programs will devolve into open space acquisition rather than farmland preservation programs (King 1988). Easements may ease growth and tax pressures on the farms, but by themselves may do little to protect the farms from other conflicts with urbanization.

Several researchers have conducted investigations of conservation easement programs in the U.S. Daniels (1991) and Coughlin et al. (1980) provide historical reviews of conservation easement programs. Daniels expressed skepticism that conservation easement programs alone could preserve a critical mass of farmland, but emphasized their potential effectiveness when used in conjunction with other farmland preservation efforts such as agricultural zoning. Even when a conservation easement program protects a modest amount of farmland it can play an important role in dispelling the perception of declining agricultural viability, the "impermanence syndrome" that discourages agricultural investment (Coughlin et al. 1980). Ultimately, the profitability of farming in an area was perceived as the driving force behind the success or failure of farmland preservation efforts.

Wichelns and Kline (1993) reviewed the relationship of cost to the characteristics of preserved parcels in Rhode Island. The appraised value of development rights was positively impacted by road frontage and panoramic views of water. Values were negatively correlated with the size of the parcel, its distance to urban or

recreational areas, and the duration of the program at the time of sale. Morris (1988) examined economic efficiency in the selection of New Hampshire parcels, concluding that expanding the formal use of quantitative scoring criteria could allow purchase of development rights on more acreage with a given level of program funding, while at the same time improving the levels of desirable parcel attributes.

Lessley (1988) discussed the integration of Maryland's conservation easement program with the formation of agricultural districts. Average asking prices and actual easement acquisition costs fell during the period from 1980 to 1986, consistent with declining farmland prices during the period.

King (1988) reviewed the political issues raised by conservation easement programs. Distributing easement purchases throughout a state improves the program's future funding prospects, but lowers the likelihood of protecting a critical mass of farmland. King noted that many applicants to Massachusetts' conservation easement program were in the midst of financial hardship, raising concerns about whether the program was protecting profitable farmland. Given the diversity of interest groups involved, the need for balanced economic and political objectives was expressed, as was the need for coordination with broader environmental policy goals.

Evidence exists that public support for farmland preservation may be directed more toward environmental amenities and open space preservation than protection of agriculture per se (Kline and Wichelns 1996). As Derr (1988) noted, at the rural-urban fringe, political interests that support farmland preservation may simultaneously oppose agricultural operations that produce noise, spray drift, and manure odor.

The role of participants' attitudes and reasons for enrolling in the program, and the impact of the conservation easement sale on the farm operation have been little explored previously. Participants' attitudes and reasons for participating are important because they give insight into the long run ability of such programs to continue to attract enrollees. It also provides a picture of who is participating, and which types of program incentives may be most important. The impact of easement sales on the farm operation is also important because sale proceeds may allow farmers to expand their operation or pay off debt, strengthening the farm.

Given that conservation easement programs are voluntary, the landowner makes

¹ Conservation easements and development rights are similar but technically different; a conservation easement is the right to prevent development on a piece of property, while a development right is the right to build on that property.

the first move in applying to sell an easement. The theory of irreversible investment under uncertainty (Dixit and Pindyck 1994) is an appropriate conceptual tool for interpreting a landowner's decision about whether to sell a conservation easement. The pertinent features of the problem are that (1) the easement sale is essentially permanent, (2) the landowner has the option to delay making a decision, and (3) the landowner does not know with certainty which decision is best. If downside risk can be reduced by waiting and learning more, then keeping the option to sell an easement alive has value to the landowner. To justify selling an easement, the net benefit to the landowner not only must be positive, it must exceed the "option value" of waiting.

Factors that would be expected to increase the expected net benefit of selling an easement include the land's agricultural value, its current and future market value, the current and future profitability of farming, the urgency of pressing financial demands such as high debt levels or insufficient retirement savings, and the strength of the landowner's attitudes supporting farmland preservation. Factors that might lower the riskiness of selling an easement versus selling to developers include the proximity of retirement (a shorter planning horizon implies less uncertainty), the participation of nearby landowners, and the permanence of other farmland preservation policies such as zoning.

Conceptually, a landowner is most likely to sell a conservation easement if the expected net benefit of program participation is high and the risk is low. Thus, for example, economic theory might predict that an older owner of highly productive farmland who holds strong views supporting farmland preservation would be a relatively likely participant in the program. Similarly, within a group of participants, a landowner with such characteristics would be expected to require a lower payment in return for the development rights on the farmland.

Development of Pennsylvania's program

In many parts of Pennsylvania, residential and commercial development compete with agriculture for land. This conflict arises because communities have historically formed and expanded near the most productive farmland (Nelson 1990). The problem is most acute in southeastern Pennsylvania, where eight of the state's top 10 agricultural producing counties face population and development pressure from the nearby Philadel-

phia area, New Jersey, Baltimore, and Washington, D.C.

As development spreads into rural areas, farmers may face regulation of activities considered to be nuisances by non-farm residents, higher property taxes to support services mainly for new residents, damage to crops, and exercise of eminent domain to acquire farmland for public services such as roads and reservoirs (Nelson 1990). In addition to rising production costs, farmers often have the opportunity to sell their land to developers at attractive prices, providing further disincentive to invest in agriculture.

This conflict for space and the importance of agriculture has long attracted the attention of farmers, lawmakers, municipal officials, growth boosters, home buyers, and environmentalists. In addition to providing jobs and income to many Pennsylvanians, agriculture offers scenic benefits and is an important part of the state's culture and history. Pennsylvania has nearly 50,000 farms, and over one fourth of the state's land is devoted to agriculture. Cash receipts from Pennsylvania crop and livestock production totaled over \$3.7 billion in 1993, the largest of any northeastern state (U.S. Department of Agriculture 1994).

The Pennsylvania legislature has authorized a wide variety of farmland preservation programs, including preferential tax assessment, agricultural zoning, creation of agricultural security areas (sometimes known as agricultural districts), right-to-farm laws, benefit assessment exemptions, review of eminent domain actions, and agricultural conservation easements. These programs generally enjoy strong public support; in a 1990 survey of over 3,600 Pennsylvanians, 70% said that preservation of farmland should receive greater attention (Lembeck et al. 1991). Until recently the predominant preservation techniques used in Pennsylvania were agricultural zoning and preferential tax assessment.

The concept of preserving Pennsylvania's farmland by government acquisition evolved over more than two decades prior to enactment of the agricultural conservation easement program. In 1968 the Pennsylvania General Assembly approved Act 442 authorizing the Commonwealth and its counties to preserve, acquire, or hold land to preserve open space near urban areas, meet recreational needs, and protect natural resources (including farmland). While this act provided state- and county-level authority to acquire farmland for the public's benefit, no specific pro-

grams were outlined and the authorization went unused.

In 1975, Lancaster County adopted a plan that recognized the impact of population growth on highly productive farmland, identified more than 100,000 acres of nonagricultural land suitable for development, and called for the preservation of 278,000 acres of the county's farmland. The first direct action to acquire farmland was taken at the county level in 1980, when Lancaster County appointed a board to designate agricultural preserves and administer a voluntary deed restriction program. A deed restriction, as used in Lancaster County's program, is similar to a conservation easement in many respects. The program acquired conservation easements on 5,500 acres of farmland before it was merged with the statewide program in 1989 (Daniels 1991).

Serious discussion about how to design and finance a statewide conservation easement program in Pennsylvania began in 1986; a rudimentary program outline and a decision to fund the effort with a bond issue was made in 1987. In the following November general election, nearly 70% of Pennsylvania voters answered "yes" to a referendum question asking if they favored incurring a \$100 million debt to purchase conservation easements from farmers. The program was enacted as an amendment to the Agricultural Security Areas Law and final review and decision-making was assigned to a new State Agricultural Land Preservation Board. The statute authorizing the program, administrative guidelines, and all subsequent policy make it abundantly clear that the purpose of the program is to preserve viable farmland, not merely open space.

Eligibility to sell a conservation easement under the program depends on meeting five basic requirements: (1) the farmland tract must be located in an agricultural security area (known elsewhere as an agricultural district) established under state law by a local government unit, (2) the applicant farm operation must generate or be capable of generating at least \$25,000 in annual gross receipts, (3) 50% of the land must be in Natural Resource Conservation Service (NRCS) soil classes I through IV, (4) 50% of the land must be harvested crop land, pasture, or grazing land, and (5) the yield per acre of agricultural commodity must meet the county average for harvested crop land. In addition to these basic requirements, county agricultural land preservation boards may add further requirements.

Farmland owners who are interested in

selling a conservation easement apply to their county agricultural land preservation board. As of June 1994, when the survey was conducted, 35 of Pennsylvania's 67 counties had created boards and 32 counties had been certified to participate in the program. If the farmland meets the basic eligibility requirements, it is scored using land evaluation and site assessment criteria set up by each county and approved by the State Board. The highest scoring farms are then appraised to determine the market and agricultural value of the easement, and the process of negotiating the final sale price and other details is carried out. The farmland owner receives a cash payment, which is considered a capital transaction for tax purposes, and the basis of the real property is reduced accordingly. After a conservation easement has been sold on a tract of farmland, the current owner and future purchasers or heirs to the land hold all of the property rights intact except the right to build on that land. Pennsylvania's program initially allowed purchases either to let the landowner buy back the conservation easement after 25 years, or to be held in perpetuity (with no option of buyback). Participating counties only purchased easements in perpetuity, however, leading to a state-level program change in 1994 formally removing the buyback option.

Location and cost of easement sales

Pennsylvania's agricultural conservation easement program purchased 205 conservation easements statewide from the beginning of the program in December

1989 to December 1992. Conservation easements on a total of 24,347 acres were purchased for \$50,882,900, an average of \$2,090 per acre (by May 15, 1997 the number of easements purchased had grown to 750, covering 94,283 acres in 37 counties, at a cost of \$184,495,000). Purchases through December 1992 (for which detailed information is available) were made in 21 counties. Figure 1 reflects the concentration of easement purchases in counties where high agricultural sales coincide with heavy development. Eighty-five percent of the purchases occurred in only eight southeastern counties, while no easements were purchased in two highly productive counties not subject to strong development pressure. Lancaster County, which leads the state in agricultural sales per acre (U.S. Department of Commerce), alone accounted for 38 % of the easement purchases.

Survey data collection

The first 205 Pennsylvania farm owners selling agricultural conservation easements were surveyed in the Spring of 1994. The survey population included all farm owners who sold easements between December 1989 and December 1992. The survey asked sellers to describe their farm and major farm products, their reasons for selling the easement, the use made of proceeds from the sale, employment on and off the farm, and general household information. The survey used a modified Dillman approach with an initial mailing, a reminder postcard, and a second letter and survey for non-respondents.

A total of 161 completed questionnaires

was received, representing an overall response rate of 78.5%. In the remainder of the paper, those who sold conservation easements will be referred to as participants or respondents. Pennsylvania farmers in counties where the program was active at the time of the survey who did not sell easements will be referred to as nonparticipants.

Survey results

Participants were significantly older on average than nonparticipating farmers in those counties where the program was active, as shown in Table 1. This result is consistent with the theoretical expectation that older farmers would face lower uncertainty regarding the program, and would

Table 1. Age distribution of participants vs. non-participants

Age group	Program participants	Non-participants*
< 25	5%	2% [‡]
25-34	3%	13% [‡]
35-44	14%	22% [†]
45-54	21%	22%
55-64	28%	20% [†]
65	30%	21% [‡]

* participating counties only, calculated after subtracting participant numbers from aggregate numbers (1992 Pennsylvania Census of Agriculture, U.S. Dept. of Commerce)

[†] denotes statistically significant difference at the 0.05 level between percentages of participants and non-participants within an age group

[‡] denotes statistically significant difference at the 0.01 level between percentages of participants and non-participants within an age group

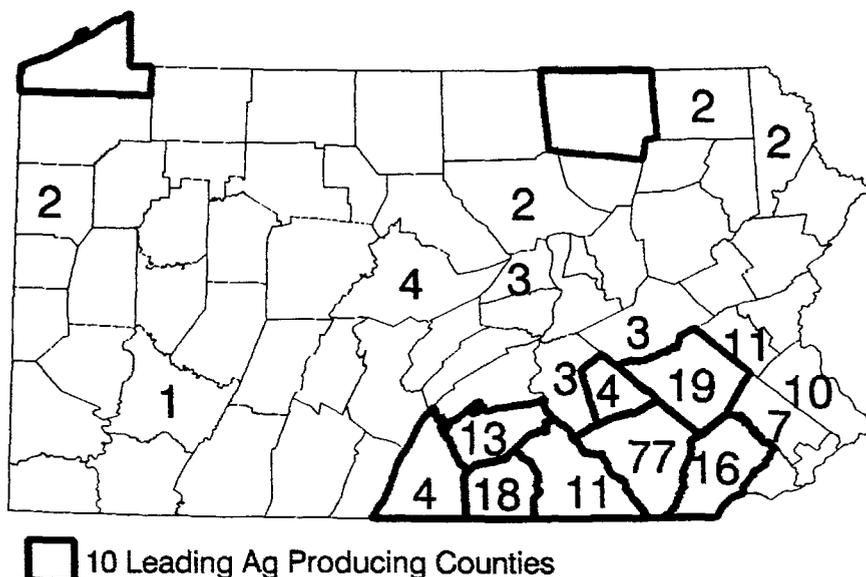


Figure 1. Number of easement sales by county, 12/89-12/92, compared to top 10 leading agricultural counties

therefore be more likely to participate. Older farm owners are likely to have a shorter planning horizon than younger farm owners, they will realize a shorter stream of net benefits from the farm's operation, and they are more likely to act on retirement and estate-related considerations.

Reasons for participation. Table 2 summarizes the reasons participants said they sold a conservation easement on their land. Three broad reasons emerged from the various responses: agricultural preservation, finances, and retirement. As respondents often listed multiple reasons, three additional categories representing possible combinations of the basic categories were formed.

Over half of the respondents fell into the "agricultural preservation only" category, over one quarter of the respondents listed both agricultural preservation and financial reasons, just one in ten respondents gave only financial reasons, and the number of respondents including retire-

Table 2. Reasons for selling conservation easements, as reported by program participants

	Number of responses	Percent of responses
Preserve farmland & ag. base	89	34.8%
Stop development	42	16.4%
Needed money	29	11.3%
Pay debt	28	10.9%
Keep farm in family	20	7.8%
Farm operations & repairs	11	4.3%
Retire	10	3.9%
Preserve open space & stewardship	10	3.9%
Lower farm price for family member	6	2.3%
Estate planning, investment, & taxes	5	2.0%
Sell farm, stop sale pressures, oppose zoning, no family to give farm to, persuaded	6	2.3%
Total	256	100%

ment in their reasons for participation was much lower than the number of retirement-age respondents. Bias toward reporting socially desirable reasons is a concern, despite the use of an open-ended question and assurance of anonymity.

Determinants of easement purchase price. Regression results shown in Table 3 confirm that per acre agricultural value was a major factor in determining easement purchase prices, as intended. Daniels (1991) notes that easement purchases on agriculturally zoned land should reflect lower development rights value, but the impermanence of zoning could reduce the effect. Of the 126 respondents who indicated that their land was zoned, 69% were subject to agricultural zoning and 8% were subject to residential zoning. In this sample, sellers of easements on agriculturally zoned land received more than \$500 less per acre on average, and the regression coefficient was statistically significant at the 0.05 level. This may occur if agricultural zoning is perceived as permanent and ultimately able to inhibit development, or may simply reflect differences between agriculturally- and non-agriculturally zoned lands in the relative proximity of public infrastructure, such as public sewer and water. Sellers of easements in residentially zoned land were paid an especially large premium. Variables which did not have a statistically significant impact on easement purchase prices per acre include reported reasons for selling an easement, total acreage, age, education, income, and involvement in local government and farm organizations.

The significant negative coefficient on the dummy variable representing location in the top ten agricultural counties is noteworthy in that it reflects greater willingness of farm owners to accept lower prices in those counties where agriculture contributes most to local economies. This result offers an interpretation of incentives based on revealed behavior. In the south-

eastern part of Pennsylvania, not only is the likelihood of development high, the consequences of development in terms of foregone agricultural sales are substantial. Although the survey did not ask respondents to reveal their religious preferences, one might also speculate that the high concentration of Amish farmers in Pennsylvania's southeastern counties influenced program participation. These groups usually are reticent to participate in government programs, however. Private conversations with a member of the State Board indicate that few (if any) Amish have participated in the program.

Referring again to the theoretical expectations regarding participation, strong views on farmland preservation and assurance of participation by other local landowners reduces uncertainty about the program's success and encourages participation at a lower offer price. Hence, we observe greater demand for the program (higher numbers of sales and lower per acre purchase prices) in areas where the stimu-

lus for farmland preservation is highest.

Changes in level of farming activity. The intent of the conservation easement program is to encourage sustained farming activity in productive areas threatened by development. Future funding and political support for the program may depend on prompt demonstration that resources are not leaving agriculture as a result of the program. Twenty-two percent of the respondents reported that they were not as actively involved in farming as they had been before the sale. The most common reasons given for reduced farming activity were health concerns, farm ownership transfer, and retirement. Table 4 shows the results of a logit regression modeling the probability that farming activity declined as a function of participant characteristics. The coefficient on age was positive and significant at the .01 level. Changes in a farm's primary agricultural product after the sale were significantly associated with decreased farming activity at the 0.05 level, and the likelihood of lower farming activity increased with the percentage of easement sale proceeds devoted to savings (as opposed to uses such as farm expansion or debt reduction). Farm income before the sale was not significantly associated with decreased farming activity.

Changes in type of farming activity. Fifteen of the 161 respondents reported that their primary farm product changed after the easement sale, and their characteristics were not representative of the entire sample. Of these 15 respondents, 12 were over 65 years old, 12 reported lower involvement in agriculture after the sale, 11 were

Table 3. Determinants of easement purchase prices

	OLS Parameter estimate	Standard error	Prob. > ITI
Intercept	1,155.01	320.29	0.0004
Ag. value / acre	0.80	0.09	0.0001
Top ten county	-980.47	272.78	0.0005
Ag. zoning	-533.49	267.86	0.0485
Residential zoning	2,589.72	629.66	0.0001
		R ²	0.48

NOTE: Dependent variable: Easement purchase price per acre

Table 4. Determinants of lower farming activity after an easement sale

	ML estimate	Wald Chi-square	Prob. > Chi-square
Intercept	-16.63	15.88	0.0001
Age	0.22	14.06	0.0002
Farm income before	-0.38	1.09	0.2967
% Proceeds devoted to savings	0.02	2.97	0.0849
Primarily animal ag. before	1.73	2.33	0.1270
Changed primary farm product	3.32	6.06	0.0138

NOTE: Response variable: Farming activity after easement sale; 1 = Not as Active, 0 = As active as before

dairy farmers before the sale, and none were dairy farmers after the sale. Eight of the 11 dairy farmers converted to either grains or field crops after the sale. The conservation easement sale apparently allowed some farmers to exit from dairying while allowing continued farming using available equipment and experience.

Use of sale proceeds. The program's objectives would be best served if participants directed the proceeds of easement sales back into the agricultural enterprises, and thus keep the land in productive use. In the survey, participants were asked to estimate the percentage of easement sale proceeds devoted to various categories. Direct farm expansion was indicated by the purchase of farmland, construction of buildings, and purchase of livestock. Other uses included savings, debt reduction, and off-farm businesses. In the aggregate, 15% of proceeds were used to directly expand farm operations, 36% were devoted to debt reduction (mortgages or operating loans), and savings accounted for 29%. Data on the observed characteristics of respondents were largely ineffective in explaining easement sale disposition. Regression analysis was somewhat successful in identifying variables associated with saving behavior, and the results are shown in Table 5. Participants who listed retirement as a motivation for participating devoted relatively more of their proceeds to savings, consistent with the hypothesis that liquid investments would be more desirable to participants nearing retirement. Participants subject to residential zoning also devoted relatively more funds to savings, perhaps reflecting uncertainty about the permanence of viable agriculture in such areas. As expected, participants who were less actively involved in agriculture after the easement sale were likely to devote more of the sale proceeds to savings.

Discussion

Conservation easements are one of several policy tools for preserving farmland. The effectiveness of agricultural conservation easements is debated by policymakers because it is a relatively expensive program and its recent development means there is little experience with how well it works. The results of this paper suggest that farm owners who sell conservation easements are significantly older on average than the Pennsylvania farming community. Most program participants said they were motivated to sell an easement by a desire to preserve farmland and farming as a way of life. Over half of the respondents listed only preservation-related reasons as a justifica-

tion for their participation.

Despite the seeming altruism of these responses, there are clear financial benefits to participating in the program, especially for those farmers nearing retirement. The large cash payment from an easement sale simplifies retirement planning, and the reduced farm value can be useful in transferring ownership within a family. A number of respondents said they sold a conservation easement to allow younger generations to continue operating the family farm. Financial concerns do appear significant, and may explain the generally older age of participants.

The program in general did not seem to change the farm operations dramatically. More than three quarters of the respondents reported that they were as actively engaged in farming after the sale as they were before. Those who reported lower farming activity or changing their farm's primary product were mainly older farmers nearing retirement. The influx of funds also did not seem to lead to significant additional agricultural activity, such as would have occurred if participants used the proceeds to expand their operations. Only 15% of the proceeds from the easement sales were used towards expanding farm operations.

Even though the program may not have changed the farms dramatically, the proceeds may have played an important role in just helping the farms to stay in operation. More than one third of the proceeds were used to reduce debt, helping strengthen the farms' financial position and thus providing additional farmland preserving benefits. This should be viewed as a secondary benefit of the program; there are better policy tools for targeting assistance to farms which need financial assistance, so debt reduction should not be used as a justification for conservation easements.

Information about the initial easement sellers, as presented and analyzed in this paper, is useful and necessary to understand who is selling easements, their motivations for doing so, and the impact of

those sales on their farms in the short run. The long run impact on farms is less clear from this information. Conservation easement programs protect the land from development but do little to preserve other elements needed for a viable agricultural operation. Nuisance laws still apply and can end up restricting agricultural activities on the farms. There is no guarantee that necessary agricultural input suppliers or marketing channels will remain in the community. A loss of local input suppliers or marketing channels potentially would make it cost-prohibitive for a farm to continue operating profitably on the preserved land.

What happens to preserved farms under these long run circumstances is unclear; theoretically the farms could turn into a liability for the owner, who cannot use it for anything other than agriculture, or they could simply become protected estates for wealthy hobby farmers. Because counties are only purchasing a conservation easement instead of a development right, in either event they will not even be able to use that land, so it could just sit idle. Under either of these scenarios, the program could end up primarily being an open space program (as King [1988] suggests). To help prevent this from occurring, it is essential to preserve a critical mass of farmland within any one area. Several counties have begun developing such masses of preserved farmland. Private conversations with officials in Adams, Lancaster, and York Counties, for example, indicate that contiguous blocks of enrolled parcels are developing.

The long-run questions about whether these preserved masses of farmland will be enough to also preserve farming itself, if conservation easements instead merely preserve open space, and the impact of politics on program performance need to be addressed in the future as states have more experience with purchase of conservation easement programs. Whether a critical mass of farmland can be preserved depends upon several unanswered questions. The results of this study suggest

Table 5. Determinants of easement sale proceeds devoted to savings

	OLS Parameter Estimate	Standard Error	Prob. > T
Intercept	53.74	10.05	0.0001
Income before sale	-5.71	1.70	0.0010
Less active after sale	26.72	7.67	0.0007
Residential zoning	20.66	10.57	0.0527
Retirement motivation	24.50	12.81	0.0580
Years farm in family	0.14	0.06	0.0113
Ag. preservation motivation	15.14	5.49	0.0067
		R ²	0.33

NOTE: Dependent variable: Percentage of sale proceeds devoted to savings

that early participants are more likely to be motivated by a concern with saving farmland than with the proceeds of the sale. A voluntary program may not provide enough participation, particularly of the most sensitive lands. More troubling is the fact that no one knows how much farmland is enough to preserve agriculture in a community.

The high cost of the program, at least in Pennsylvania, may also reduce the probability of generating such a critical mass of farmland. The initial bond funding the Pennsylvania program was being rapidly depleted and essentially depleted by 1996, necessitating a need to find an alternative revenue source. To augment the bond authorization, the state legislature earmarked two cents of the cigarette tax for the program, which generates approximately \$20 million a year.

The high program cost increases the need to sustain political support from throughout the state or it could be easily eliminated. Program support has been continued, in part, by making easement purchases statewide (even though arguably only in certain regions is major farmland loss a threat). The long run impact of this political reality is unclear; at the time the people in the study participated in the program, only 20 of Pennsylvania's 67 counties had completed forming the requisite farmland preservation board and procedures, and thus were eligible for the program. Currently 42 counties are eligible. Instead of concentrating purchases, this change will spread limited program funds across more counties, further dispersing purchases and making critical masses even more difficult to form. So far the scale of easement purchase funding in these counties is relatively small, which means that the better funded, more agriculturally significant counties should continue to dominate easement purchases.

REFERENCES CITED

- Coughlin, R.E., J.C. Keene, J.D. Esseks, W. Toner, and L. Rosenberger. 1980. Executive Summary, The Protection of Farmland: A Reference Guidebook for State and Local Governments. Report to the National Agricultural Lands Study, Amherst MA: Regional Science Research Institute.
- Daniels, T.L. 1991. The Purchase of Development Rights: Preserving Agricultural Land and Open Space. *Journal of the American Planning Association*. 57:421-431.
- Derr, D.A. 1988. Historical Overview of Purchase of Development Rights Programs in the Northeast in Purchase of Development Rights in the Northeast, ed. J. Mackenzie. Bulletin 474. Newark DE: Delaware Agricultural Experiment Station.
- Dixit, A.K., and R.S. Pindyck. 1994. Investment Under Uncertainty. Princeton NJ: Princeton University Press.
- Geisler, C. 1993. Ownership: An Overview. *Rural*

- Sociology*. 58:532-546.
- King, W.H. 1988. Political Issues in Purchase of Development Rights Program Administration in Purchase of Development Rights in the Northeast, ed. J. Mackenzie. Bulletin 474. Newark DE: Delaware Agricultural Experiment Station.
- Kline, J. and D. Wichelns. 1996. Public Preferences Regarding the Goals of Farmland Preservation Programs. *Land Economics*. 72:538-49.
- Lapping, M.B., T.L. Daniels, and J.W. Keller. 1989. *Rural Planning and Development in the United States*. New York: The Guilford Press.
- Lembeck, S.M., F.K. Willits, and D.M. Crider. 1991. Public Attitudes Toward Farmland Preservation in Pennsylvania: Analysis of a Statewide Survey. Report 226, Department of Agricultural Economics and Rural Sociology. University Park PA: The Pennsylvania State University. Lessley, B.V. 1988. Integrating Purchase of Development Rights Programs with Agricultural Districts and Use-Value Assessment in Purchase of Development Rights in the Northeast, ed. J. Mackenzie. Bulletin 474. Newark DE: Delaware Agricultural Experiment Station.
- Mackenzie, J. 1988. Purchase of Development Rights in the Northeast, ed. J. Mackenzie. Bulletin 474. Newark DE: Delaware Agricultural Experiment Station.
- Mittleman, D., D. Katz, and J. Vilms. 1985. Purchase of Development Rights (PDR) Handbook. Sonoma Land Trust.
- Morris, D.E. 1988. A Critical Look at PDR Program Efficiency in Purchase of Development Rights in the Northeast, ed. J. Mackenzie. Bulletin 474. Newark DE: Delaware Agricultural Experiment Station.
- Nelson, A.C. 1990. Economic Critique of U.S. Prime Farmland Preservation Policies. *Journal of Rural Studies* 6:119-142.
- U.S. Department of Agriculture, Economic Research Service. 1994. *Agricultural Outlook*. AO-209. Washington DC, July.
- U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1994. 1992 Census of Agriculture, Volume 1 Part 38: Pennsylvania State and County Data. AC92-A-38. Washington DC: U.S. Government Printing Office, July.
- Wichelns, D., and J.D. Kline. 1993. The Impact of Parcel Characteristics on the Cost of Development Rights to Farmland. *Agricultural and Resource Economics Review* 22:150-158.

Effects of Mediterranean shrub cover on water erosion (Valencia, Spain)

V. Andreu, J.L. Rubio, and R. Cerni

Interpretive summary

Mediterranean forest areas are ecosystems in fragile equilibrium, and under the pressure of a range of degradative processes that increase the risk of desertification. Soil erosion is one of the most serious processes of degradation in these areas. To diminish its effects different approaches have been traditionally used most of them based on mechanic structures (bench terraces, ditches, etc.). Biological approaches like the planting of shrubs for soil protection have been scarcely studied. Because of this lack of information and experience, the influence of typical forest Mediterranean shrub vegetation on soil erosion processes and its comparison with two foraging species (*Medicago arborea* L. and *Psoralea bituminosa* L.) is the objective of this study. It has been observed that natural vegetation gives always the best protection, reducing comparatively a 74.96% of soil loss. However the tested species, mainly *Medicago arborea*, show good protection rates reducing a 37.60% of sediment production.

Key words: erosion control, Mediterranean shrubs, runoff, sediment, soil water erosion.

ABSTRACT: The effects of a typical Mediterranean shrub vegetation and two foraging species (*Medicago arborea* L. and *Psoralea bituminosa* L.) on soil protection against water erosion were studied between 1988 and 1993 under field conditions on a set of experimental plots. Comparison of the bare and vegetated plots clearly shows that development of vegetation affects physical and chemical soil characteristics. Natural vegetation gives greater soil protection than the other studied species, reducing soil loss by an average of 74.96% compared to the bare soil. The other species tested, *Medicago arborea* L. and *Psoralea bituminosa* L., substantially affect soil retention, but reduce sediment production only by 37.60% and 11.32% respectively. Statistical analysis shows that vegetation cover and rain characteristics (quantity and I_{30}) are the main factors influencing runoff and sediment production.

The authors are the contract researcher, director of the center and associate researcher of the Centro de Investigaciones sobre Desertificación-CIDE Cami de la Marjal, s/n, Apartado Oficial 46470-ALBAL, Valencia, Spain.

The authors thank the Conselleria de Medio Ambiente (Generalitat Valenciana) for providing

the study zone facilities, and E. Barrachina, D. Rius, V. Garcia and I. Vargas for their help in the laboratory labor. EEC projects N° EV4V-112-C(AM) and ENV4-CT95-0181 gave the financial support.

J. Soil and Water Cons. 53(2) 112-120