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Profiles of US farm households adopting conservation-compatible practices

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Abstract

In recent years, the United States (US) government has put increasing emphasis on conservation programs geared toward rewarding good stewardship on working farmland. And, while the United States Department of Agriculture's (USDA) farmland retirement programs continue to command the lion's share of the conservation budget, roughly 80 percent of current land retirement contracts are due to expire before the end of the decade. With the 2007 US farm bill debate underway, policy makers will be making decisions about the future direction of farm conservation efforts. This paper examines the business, operator, and household characteristics of farms that have chosen to adopt conservation-compatible practices, with and without financial assistance from conservation programs. It sheds light on the relationship between adoption of conservation-compatible practices and conservation behavior, and how this relationship varies between farm business, operator, and household characteristics. Findings indicate that farm operator and household attributes, and farm business characteristics, affect the likelihood that a farmer adopts certain kinds of conservation-compatible practices.
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Keywords: Conservation programs; Conservation management practices; Conservation structures; Farm households; Conservation reserve program; Environmental quality incentives program

Introduction

Farm operators who own their land or who expect to lease their land year after year have a profit motive to insure that the quality and productivity of their land do not deteriorate over time. Furthermore, farm operators typically live near their farms, giving them an incentive to reduce some types of farming-related environmental degradation. Nonetheless, some conservation practices require an investment of funds and can reduce farm profitability, particularly in the short-run, making their adoption costly. In addition, much of the unintended environmental damage caused by farm production occurs far downstream. Farming-related environmental problems are less likely to be addressed if the farm operator does not directly or indirectly benefit from adopting conservation practices. As a result, farming remains a major source of some pollutants (Ribaudo, 2000; Claassen et al., 2001).

The United States (US) government provides technical and financial support for farm conservation efforts as incentives to reduce onsite and offsite environmental impacts. These programs are voluntary, and their cost and effectiveness depend on what farm operators demand in compensation for altering farming practices. Considerations other than farm profits and environmental outcomes, such as household resource constraints and opportunities, farm structure and ownership, and personal goals, can affect the decision to adopt conservation practices or participate in conservation programs. The determinants of farm operator adoption of selected conservation practices and participation in the United States Department of Agriculture's (USDA) conservation programs are

Abbreviations: ARMS, Agricultural Resource Management Survey; CREP, Conservation Reserve Enhancement Program; CRP, Conservation Reserve Program; EQIP, Environmental Quality Incentives Program; ERS, Economic Research Service; HEL, highly erodible land; NRCS, Natural Resources Conservation Service; USDA, United States Department of Agriculture; WRP; Wetland Reserve Program

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examined in this study. Understanding how potential participants respond to market and program incentives is achieved by identifying the characteristics of farm households that have adopted conservation practices.

Farm and ranch[1] land accounts for about half of the land in the 48 contiguous States. Farming practices adopted by the roughly two million US farm operators have a major impact on soil erosion, sedimentation levels in streams and rivers, nutrient and pesticide run-off, groundwater contamination, and air quality. Nearly 71 percent of farmland is located in watersheds where nitrate, phosphorous, coliform bacteria, or suspended sediment levels surpass criteria for safe, water-related activities (Smith et al., 1994). National water quality assessments conducted by the US Geological Survey suggest that agriculture is a leading source of water quality problems in the US (Ribaudo, 2000). Agriculture has also been cited as a major contributor to declining levels of groundwater and increasing groundwater contamination, wildlife habitat loss, increases in threatened and endangered species, air pollution, and toxic *Pfiesteria* outbreaks (Claassen et al., 2001; EPA, 2004). Improved conservation practices can mitigate these unintended environmental consequences of agricultural production. For example, farming practices such as conservation tillage and crop rotation reduced soil erosion on US cropland by no more than 40 percent between 1982 and 1997 (Claassen et al., 2004). Variable rate fertilizer application has decreased nutrient loadings into the environment in some cases (Bongiovanni and Lowenberg-DeBoer, 2004). The establishment of permanent cover on farmland enrolled in land retirement programs has improved water quality, wildlife habitat, and increased carbon sequestration (Feather et al., 1999; Ribaudo et al., 1990).

Economists typically assume that the decision to adopt a specific farming practice is based on profit maximizing behavior given resource constraints. Indeed, research has shown that the operator's profit motive is often sufficient to elicit cost-cutting conservation efforts. For example, 75 percent of the reduction in soil erosion by US corn producers between 1982 and 1997 can be attributed to the adoption of conservation tillage practices for business reasons (Hopkins and Johansson, 2004). But is profit the only motive behind the decision to practice good stewardship? Roughly 63 percent of farm operators in the US are classified as ''residential'' or ''lifestyle'' farmers, or are retired (USDA-ERS, 2005), suggesting that the decision to pursue farming is based on quality-of-life factors as well as the farm's ability to generate profits. Concerns over succession (Wilson, 1997, p. 82; Battershill and Gilg, 1997, p. 222), the desire to limit the time and energy spent farming (Lobley and Potter, 1998, p. 423; Loftus and Kraft, 2003, p. 81), and the need for income stability (Loftus and Kraft, 2003, p. 81) can also affect decisions about farming practices and conservation program participation. Indeed, studies of farmer adoption of conservation practices and participation in conservation programs in the European Union and the US have found that quality-of-life factors and personal attributes of farm operators also influence the decision. For example, Caswell et al. (2001) found that farmer education and the operator's willingness to pursue offsite expert advice had a positive influence on the decision to adopt ''management-intensive'' conservation technologies in the US. Loftus and Kraft (2003) found that farmers who more frequently visited extension agents were more likely to enroll land into conservation programs. Length of residency in a given location has also been found to be positively related with participation in the Environmentally Sensitive Areas Scheme in the European Union (Wilson, 1997).

Understanding the economic and demographic profiles of farm households adopting conservation-compatible practices, with and without Federal program assistance, is an important first-step in designing conservation policies and programs that maximize the environmental benefits from public and private conservation outlays. The objective of this paper is to understand the factors associated with the decision to adopt conservation-compatible practices. To meet this objective, information from the USDA's Agricultural Resource Management Survey (ARMS) on farm production and household characteristics is used to compare households that have and have not incorporated conservation practices into management decisions. The remainder of this paper is organized as follows. The next section describes the conservation programs available to farm operators and the kinds of practices supported by the federal government on a cost-share basis. This is followed by a section describing the data and the research methodology. Discussion of the results and policy implications conclude the paper.

Conservation policy, land retirement programs, and working-land practices

The USDA's Natural Resources Conservation Service (NRCS) and the Farm Service Agency manage several voluntary conservation programs for private land with the objective of fostering good stewardship practices. The NRCS lists 151 structural farming practices (for example, construction of riparian buffers, dams, and sediment basins) and 16 management practices (for example, crop rotation, pest management, and nutrient management) that are eligible for Federal cost-sharing under one or more of its conservation programs (NRCS, 2004). Each practice addresses one or more of the major concerns underlying USDA's conservation policy: soil and land conservation, water quality and conservation, crop nutrient management, livestock manure management, wildlife habitat management, and air quality improvement (USDA, 2003). Federal programs providing conservation funding directly to farmers and ranchers focus largely on either: (1) retiring

[1]''Farming'' is based throughout the rest of the paper in the general sense to include crop and livestock operations.

environmentally sensitive farmland from production or (2) improving conservation practices on working farmland. The Conservation Reserve Program (CRP) is the primary land retirement program operated by USDA, while the Environmental Quality Incentives Program (EQIP) is one example of the Department's working-land conservation programs.

The CRP was authorized by the 1985 Farm Security Act to retire environmentally sensitive land from agricultural production for 10–15 years. In return for an annual rental payment and partial reimbursement for the cost of establishing and maintaining approved ground cover, participants agree to take enrolled land out of production and plant grasses, trees, or other conservation cover.[2] Based on the distribution of hectares enrolled in the CRP, the program puts most of its effort into planting land to grasses, largely through enrollment of whole fields (Fig. 1). Nonetheless, while the number of hectares involved in working-land compatible practices is small, such signups amount to 20 percent of the contracts outstanding in 2001.[3] Despite its focus on land retirement, CRP's size made it the primary source of Federal assistance for conservation activities pursued by working farms until recently (Fig. 2).

EQIP provides financial and technical assistance to help participants install or implement conservation practices on eligible agricultural land. EQIP is a working-land program designed to help farmers institute conservation-compatible practices and integrate conservation structures into their farming operations. For structural and vegetative practices, EQIP can reimburse up to 75 percent of the installation costs.[4] Producers can also receive incentive payments for adopting management practices. Since its inception in 1996, $720 million USD in EQIP funds have helped nearly 46,500 ranchers and farmers improve air, soil, and water quality on private working-land (USDA, 2005). By law, 60 percent of EQIP funds go to livestock producers, including large confined livestock operations (Fig. 1).

In the years following CRP's implementation, most conservation payments to farmers funded land retirement. But with the 2002 Farm Security and Rural Investment Act, funding for working-land programs has increased (Fig. 2). While land retirement and working-land practices are not mutually exclusive, one would expect land retirement to appeal to a different segment of the farming population than working-land practices. Land retirement may appeal more to operators who wish to curtail their

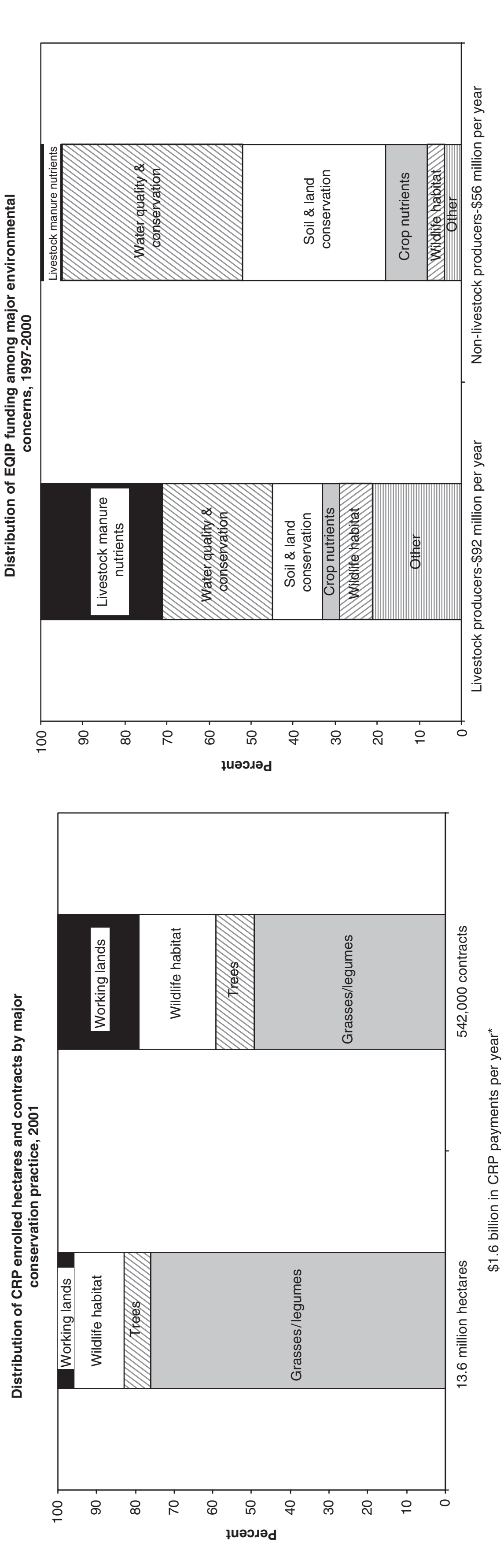

Fig. 1. Distribution of CRP-enrolled hectares and contracts by major conservation practice (2001) and EQIP funding among major environmental concerns (1997–2000). Notes: Distribution of hectares enrolled in CRP/CREP and contracts as of November 2001. For EQIP, bars are based on rental and cost-share payments disbursed to program participants between 1997 and 2000. "Other" includes installation of fencing, which accounted for 11 percent of the obligated funds for livestock producers. Source for CRP data: Barbarika (2001); source for EQIP data: USDA, 2003.

[2]Limited mostly to cropland, in 2004, farmers and landowners were paid $1.8 billion USD in cost-share and rental payments on roughly 14.2 million hectares of enrolled land (USDA, 2005).

[3]Many of the working-land compatible practices covered by the CRP are eligible for continuous signup. Land offered through the continuous signup program does not go through a competitive bidding process and often receives rental and cost-share payments that are higher than those received under the program's general signups.

[4]With passage of the 2002 Farm Security and Rural Investment Act, most practices are now cost-shared at 50 percent.

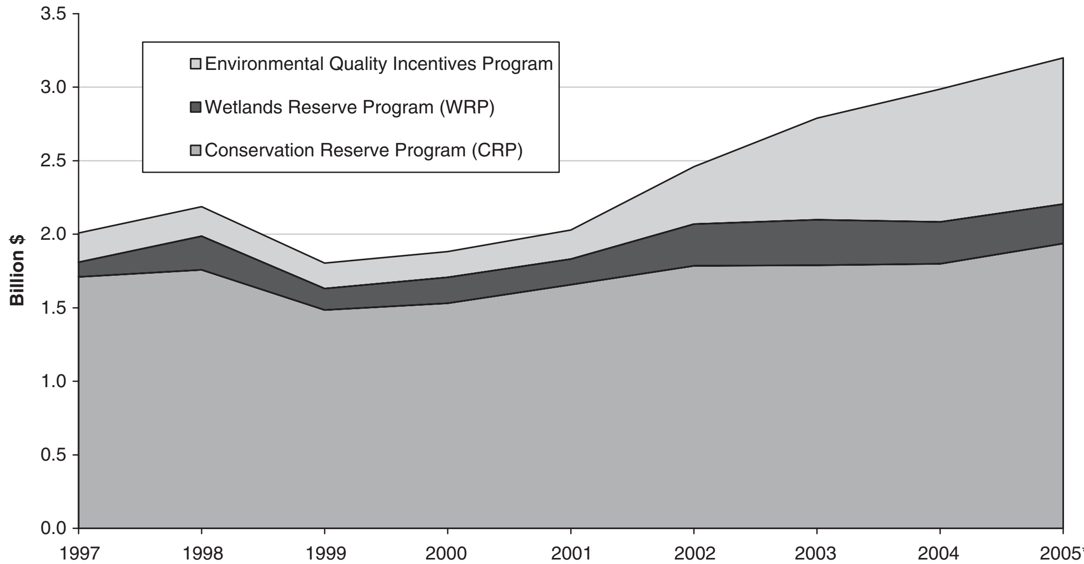

Fig. 2. USDA conservation expenditures for selected programs, 1997–2005. Source: ERS analysis of Office of Budget and Policy Analysis data. *Esimated.

farming activity, either because of retirement plans, or to take advantage of more lucrative off-farm activities. Working-land management strategies may appeal to operators who see farming as their primary occupation and can afford to invest time and managerial skill to experiment with new farming practices. Comparisons between participants in these two general types of conservation practices are the focus of this paper.

Motivation for adoption of conservation-compatible practices

Cost reduction is one argument for adopting conservation-compatible practices. For example, variable rate application of inputs not only reduces the likelihood of excessive use of nutrients and chemicals, but also it can reduce the cost of growing (or increase revenue from) a crop (Griffin et al., 2004). Nonetheless, variable rate input management may require new or retro-fitted spreaders and new management skills. The ability to spread fixed and human capital costs over more hectares makes conversion more economical. Thus, the scale of the farm operation is likely to be a major determinant in many farming practice decisions (Fernandez-Cornejo, 1994; Fernandez-Cornejo et al., 2001). For the same reason, the farmer's planning horizon can also influence cost-effective calculations. Younger farmers and those who plan on staying in farming for many years may be more willing to re-tool than farmers looking forward to retirement.

But accounting profits are not the only consideration when making farming practice decisions. Even practices that promise higher farm profits may not appeal to some operators if they require lifestyle changes that are inconsistent with household goals. If off-farm employment contributes to farm household income more than farm profit does, then minimizing the amount of time the operator spends farming may be more important than maximizing farm profits (Nehring et al., 2002).

Not all conservation practices save time or reduce costs. When adopting a conservation practice implies a drop in production or increased input cost and management skills to maintain production levels, what would motivate such a change? One reason may involve the level of adoption costs. Operators who participate in conservation programs may find the out-of-pocket expenses of conservation practices much reduced. But farm operators can also value land stewardship and the environment apart from any profit motive. While environmentalist sentiments are not the exclusive province of any particular type of farm, adoption of conservation practices may be more likely in environmentally sensitive areas and when the cost is relatively low.

Data and methods

Data used in this study

The USDA's Agricultural Resource Management Survey (ARMS) is used to characterize farm households that adopt conservation practices.[5] ARMS is the only annual source of data on the finances and practices of a nationally representative sample of US farms that includes information on the characteristics of farm operators and their households. ARMS is a collection of annual surveys that focus on the farm enterprise and on specific crops. This research uses data from the 2001 Phase III ARMS questionnaire on conservation structures installed by a representative sample of all farms in the US ($N = 5416$),

[5]The survey instruments are described at www.ers.usda.gov/data/arms/GlobalDocumentation.htm#survey.

Table 1
Characteristics of US farms and farm households, by farm typology

Variable	Retired	Residential	Low sales	High sales	
				Small	Commercial
Farm operators (1000 s)	398	933	469	135	151
Avg. farm size (hectares)	70	66	171	472	804
Avg. farm income (USD $)	4885	642	7905	41,486	155,969
Pct. of non-farm HH[a] income	102	106	99	51	27
Pct. of US farmland	7	16	21	17	32
Pct. of US cropland	6	12	17	21	41
Pct. of US farm production	2	5	8	12	59
Pct. receiving government payments	33	27	44	84	75
Pct. receiving conservation payments	17	11	10	18	19

Non-family farms are excluded so the percentage of US totals do not sum to 100. *Source*: 2003 ARMS, all versions.
[a]Households.

supplemented with Phase II ARMS data on conservation practices of farms growing specific crops. Phase II data allow for a closer look at the adoption of a consistent set of farming practices on farms growing corn (in 2001, $N = 1830$), soybeans (in 2002, $N = 1886$), and cotton (in 2003, $N = 1230$).

Family farms are the unit of analysis in this study. That is, we exclude non-family corporate and cooperative farms and other operations with a hired farm manager. Family farms operated approximately 354 million hectares of farm and ranchland in 2003 (94 percent of the total) and accounted for more than 98 percent of US farms. The household, operator, and farm characteristics of operations that have adopted one or more of a limited number of conservation practices are examined because of their broad applicability in different geographic locations and across different types of farming operations.

Farm scale and farm household characteristics influence farming practice decisions. To appreciate the importance of scale in the conservation practice decision, a farm typology[6] was constructed as a heuristic (Table 1). Retirement and residential farms are generally smaller in size and are less engaged in farming as an occupation. For corn, soybean, and cotton farms, we combine these two groups. Low sales farm operators consider farming their primary occupation, but may lack the resources needed to remain viable in the long run without significant off-farm income. Higher sales farms are more focused on farming as an income source and have the scale needed to make farming investments payoff. For analyses of corn, soybean, and cotton farms, this latter group is divided into small/higher-sales farms and commercial farms (Tables 1 and 2).

[6]The farm typology used here is a modified version of Hoppe et al.'s (2000) typology of US farms.

Conceptual model, analytical framework, and empirical methods

To facilitate comparison of farm households that have adopted conservation practices with those that have not, three broadly defined groups of conservation-compatible management practices were constructed: "standard practices", "decision aids", and "information/management-intensive" practices (Table 2).[7,8] These practices do not necessarily imply good stewardship, but their use suggests that the farm operator understands the costs and benefits of farm management practices that are compatible with conservation goals. Paired *T*-tests are used to compare farm household and production characteristics of the households adopting these strategies to the reference group of farm households that do not use these conservation-compatible practices.

To compare all family farms practising conservation activities, information on the use of conservation cover practices and structures is analyzed (Table 2).[9] These practices include (1) retiring farmland and planting it with cover crops, (2) installing structures or setting aside land to enhance wildlife, and (3) installation of conservation structures on working farmland. Household and production characteristics of farms that have chosen to retire land or install conservation structures are compared using *T*-tests, with the reference group being farm households that have chosen not to adopt any of these conservation structures.

To supplement these univariate comparisons, a random utility framework (Greene, 2003, p. 719) is used to model farmer behavior. The random utility model has seen

[7]This list of management practices builds on research reported in Caswell et al. (2001) and Quinby et al. (2006).
[8]This part of the analysis uses ARMS Phase II/III information from cotton, corn, and soybean farms.
[9]This part of the analysis uses 2001 ARMS Phase III Cost and Returns data. A complete description of the ARMS data is available at www.ers.usda.gov/data/arms/GlobalDocumentation.htm#doc.

Table 2
Definitions of farm typology, conservation compatible-practices, and conservation cover types used in the analysis

	Farm typology definitions	
Farm category	*Respondent's occupation*	*Sales*
I. Retired	Retired	<250,000 USD[a]
II. Residential/lifestyle	Other than farming	<250,000 USD
III. Low sales	Farming	<100,000 USD
IV. High sales/commercial	Farming	Small farms, sales >100,000 USD & commercial farms sales >250,000 USD
IVa. Small/High Sales[b]	Farming	Sales 100,000–250,000 USD
IVb. Commercial[b]	Farming	Sales >250,000 USD
	Conservation-compatible practices definitions	
Practice categories	*Practices*	*Environmental benefit*
I. Standard practices	Conservation tillage	Mulch-till, ridge-till, no-till practices reduce erosion
	Crop rotation	Interrupt life cycles of pests to reduce fertilizer needs; reduce erosion
	Insect/herbicide tolerant plants	Reduce need for chemical inputs
II. Decision aids	Soil testing	A first-step to targeted fertilizer applications. May reduce nitrogen leaching and phosphorous run-off
	Pest scouting	A first-step to integrated pesticide mgt. systems. May lead to reduced applications
	Soil mapping	Enables strategic input placement and timing
III. Information/mgmt. intensive	Variable rate (VR) input use	VR fertilizer/chemical application may imply farmers are using soil test results & pest scouting to target input use
	Nutrient management	As evidenced by nitrogen applications based on results of soil/plant tissue tests
	Pest management	As evidenced by use of written records on pest infestation, input applications based on university-developed thresholds, and integrated pest management practices
	Conservation cover definitions	
Cover type	*Practices*	*Environmental benefit*
I. Whole field cover	Planting whole fields to grasses or trees	Native grasses and trees planted on retired farmland provide environmental benefits
II. Wildlife enhancement	Enhancement and protection of rare or declining habitats	Native wildlife may be enhanced by installation of food stands, demarcation of sensitive wetlands, and cessation of farming or grazing
III. Working-land structures	Installation of grass waterways, filter/contour strips, and riparian buffers	Vegetative strips/filters capture sediment and organic matter and stabilize stream banks by slowing runoff and nutrient loss

Source: USDA-ERS ARMS 2001–2003.
[a]US dollars.
[b]For analyses of corn, soybean, and cotton farms.

frequent use in adoption studies of conservation practices in particular, and technology adoption in general. Caswell et al. (2001) applied this theoretical framework to estimate adoption of soil and water management practices in the US. Soule et al. (2000) used this latent utility approach to determine the relationship between land tenure and adoption of conservation practices. Loftus and Kraft (2003) used a similar discrete choice model in their study of the factors influencing the decision to enroll conservation buffers into land retirement programs. An earlier study by Lohr and Park (1995) used a sample selection approach to model farmer decisions to participate in conservation programs.

The random utility model assumes that a farm operator will adopt a conservation-compatible practice (e.g. standard or management-intensive practices) or install a conservation structure (e.g. plant conservation cover, or install working-land conservation structures) if the benefit (utility) derived from adoption of a practice is greater than it is without the practice. The utility a farmer gains from adopting one of these practices is hypothesized to be a function of exogenous variables (x_i) characteristic to farmer i; $U^*_{ij} = x'_i\beta + e_i$, with U^*_{ij} an (unobserved) latent response, β the mean response vector, and e_i a random disturbance term. Let $C_{ij} = 1$ indicate that farmer i uses the jth conservation-compatible management practice (or practices one of three conservation activities), 0 otherwise. Hence, $U_{ij} > U_{ik}$ if $C_{ij} = 1$ and $C_{ik} = 0$ for all other choices. Therefore, the choice of U_{ij} is the maximum utility gained by farmer i among all other choices.

In the case of adoption of conservation-compatible practices, a cumulative probit regression (Allison, 2003,

p. 138) was used to estimate the effects of business, operator, and household characteristics on the likelihood of a farm operator adopting one or more management-intensive conservation-compatible techniques.[10] By assuming that conservation-compatible management practices can be represented as an ordered progression in intensity from low to high management activities, and that such a progression would go from non-adopters, to adopters of "standard practices", to adopters of "decision aids" but not "management-intensive" practices, to adopters of "management-intensive" practices, the marginal effect on the probability of an individual using the next (or higher) level of technology can be estimated.

In the case of installation of working-land compatible structures, wildlife enhancement, or planting conservation cover, a multinomial logit regression (Greene, 2003, p. 720) was estimated to correlate farm structure, household, and environmental characteristics with the conservation practice decision. Because there is no apparent hierarchy among the conservation structures and practices of interest, the multinomial regression analysis attempts to identify (ceteris paribus) the factors associated with the use of different categories of conservation structures (working-land structures, wildlife enhancements, and whole-field retirements) and the absence of such structures.

Variables used in the regression analyses

Farm production characteristics

To measure the effects of farm diversification, the value of production shares from high-value crops (e.g. revenue from fruits, nurseries, and vegetables), grain crops (such as corn, soybean, rice, barley, sorghum, and wheat), and the value of production from cattle, dairy, hogs, and poultry were included in the regressions.

It is often assumed that owner–operators will be better stewards of their land because it is in their best interest. Some studies have found that land tenure security is an important component of adoption of new technologies (Soule et al., 2000). The proportion of land owned to land operated was used to measure the effect of land tenure on adoption of conservation practices.

Scale effects may be important with respect to the conservation practice decision (Lynch et al., 2001; Soule et al., 2000). Fernandez-Cornejo (1994) used total hectares operated by farms to measure scale effects on farm technical efficiency. Fernandez-Cornejo et al. (2001) also used hectares operated to measure the effects of scale on the adoption of agrobiotechnology and precision agriculture technologies. But scale effects have also been measured using gross farm income. Gunter and McNamara (1990) used the absolute value of gross farm income to measure the effect of farm size on off-farm labor supply by farm households. Gross cash farm income less government payments was used to measure the effects of farm size on decisions to adopt conservation practices.

A dummy variable indicating whether an operator used recommendations from the extension service or hired a consultant for nitrogen management was included in the cumulative probit regression. It is hypothesized that the sign of this variable will be positive; indicating that farmers considering more intensive management practices will seek advice on the costs and benefits of applying those technologies.

The economic cost-to-output ratio of the farm operation was included in the cumulative probit regression to measure farm efficiency.[11] In the multinomial logit regression, the asset turnover ratio of the farm operation was included to measure the effects of efficiency on the decision to practice a conservation activity.

Government assistance

Government payments may influence the adoption choice of some conservation-compatible practices or participation in conservation programs. Government payments include fixed income, marketing loan, disaster, and conservation payments. The expected sign of this variable is positive. Government payments less conservation payments were used to measure the effects payments have on the decision to adopt conservation-compatible practices. Payments were normalized by the total value of farm production to eliminate scale effects. Conservation payments were normalized by total hectares operated.

Household characteristics and human capital

The off-farm share of total household income was included in the regression models to measure the effect of non-farm income sources on the decision to participate in a conservation program or to adopt conservation-compatible practices. Additionally, whether the farm operator, the farm operator's spouse, or both the operator and spouse work off-farm were included as binary variables.

Education has been used to measure the effects of human capital on conservation decisions (Lynch et al., 2001). A Likert scale was used to represent the education level of respondents. A response of "1" meant that the respondent had not completed high school, while "5" meant that the respondent had at least some post-graduate education. It is hypothesized that education has a positive effect on adopting conservation-compatible practices and new technologies in general.

Retirement and succession plans may also play an important role in farm management decisions. Whether the respondent was retired or not is included as a binary

[10] The analysis focuses on corn farms that completed Phases II and III of the 2001 ARMS. Therefore, conclusions should not be extrapolated to other farm operations.

[11] This variable is calculated as 100 × (total expenses + non-cash expense paid to labor + depreciation expenses + adjusted charge to management + estimated charges to operator + total contractor reimbursed operator expenses)/(total value of production − total value of production to landlord + government payments) (Banker et al., 2001).

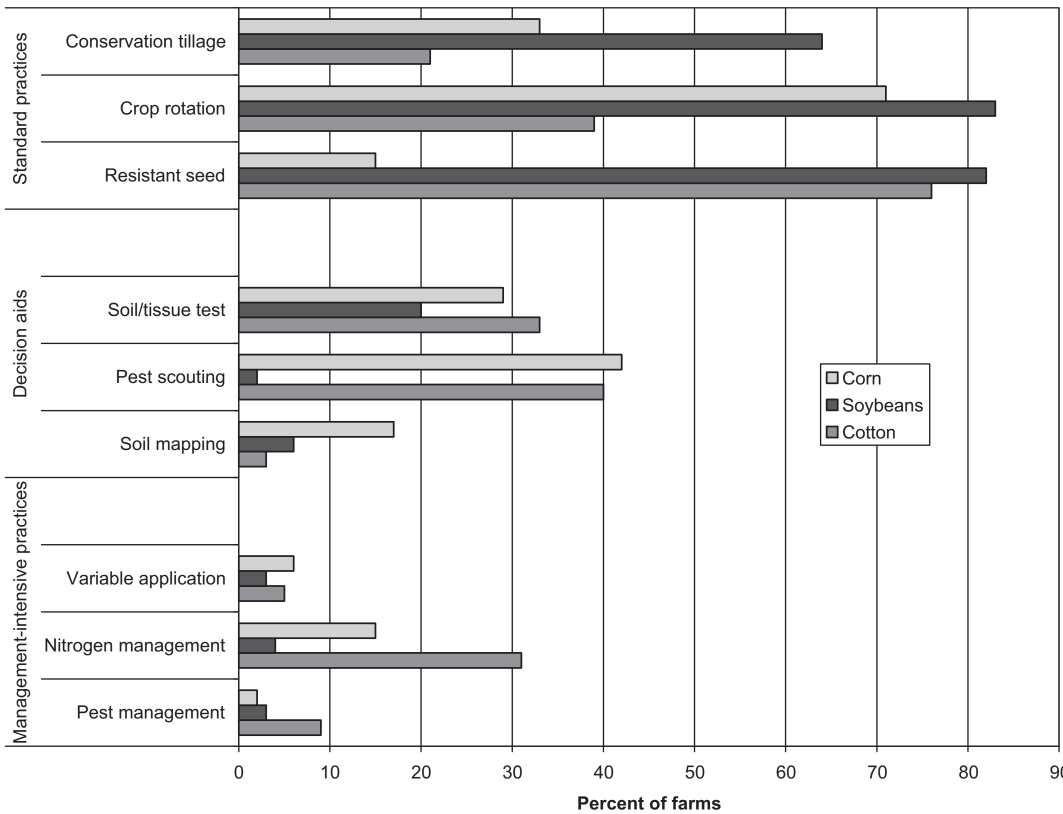

Fig. 3. Use of conservation management practices on corn, soybean, and cotton farms, 2001–2003. Notes: Non-family farms are excluded. Source: 2001–2003 ARMS, Phase II/III.

variable. Farming experience and the square of farming experience were used to measure the effect of human capital on conservation decision making.

Environmental characteristics

Highly erodible land (HEL, land with erodibility indices $\geqslant 8$) for wind and water were used to proxy environmental sensitivity (Heimlich, 2003). Because these measures were aggregated to the county level, they only roughly approximate the environmental sensitivity of an area where a farm is located. The 2001 ARMS survey of farms growing corn asked respondents directly whether any of their farmland was classified by NRCS as HEL, so our analysis of conservation-compatible practices used this more precise measure. A humidity index, aggregated to the county level, was included in the regression models to control for local effects of temperature and moisture on production.

Local/Regional economy

The shares of the work force employed in manufacturing, the service sector, and wholesale and retail trade at the county level were used to control for local economic effects. Population density (persons/square hectare) was included to measure the effects of population and land values on the choice to adopt conservation-compatible practices. Finally, the Economic Research Service (ERS) resource regions were used to control for regional effects attributable to weather, climate, and other factors characteristic to these regions.[12]

Results

Adoption of conservation-compatible management practices

Fig. 3 shows the percentages of farms growing corn, soybean, and cotton whose operators reported that they were engaged in selected farming practices that are compatible with conservation. While there are variations from one crop to the next, a high percentage of farm operators reported the use of one or more of the ‘‘standard’’ conservation-compatible practices—conservation tillage, crop rotation, or insect and herbicide tolerant plants. Fewer farm operators performed soil tests, systematically scouted for pests, or developed soil maps to help manage inputs. And still fewer farm operators reported use of management-intensive conservation practices, such as variable rate application of inputs, and nutrient and pest management systems. Because these are all working-land management practices, they are not reimbursable under any of the land retirement programs (CRP, CREP, and

[12]A description of the ERS resource regions is available at www.ers.usda.gov/Emphases/Harmony/issues/resourceregions/resourceregions.htm.

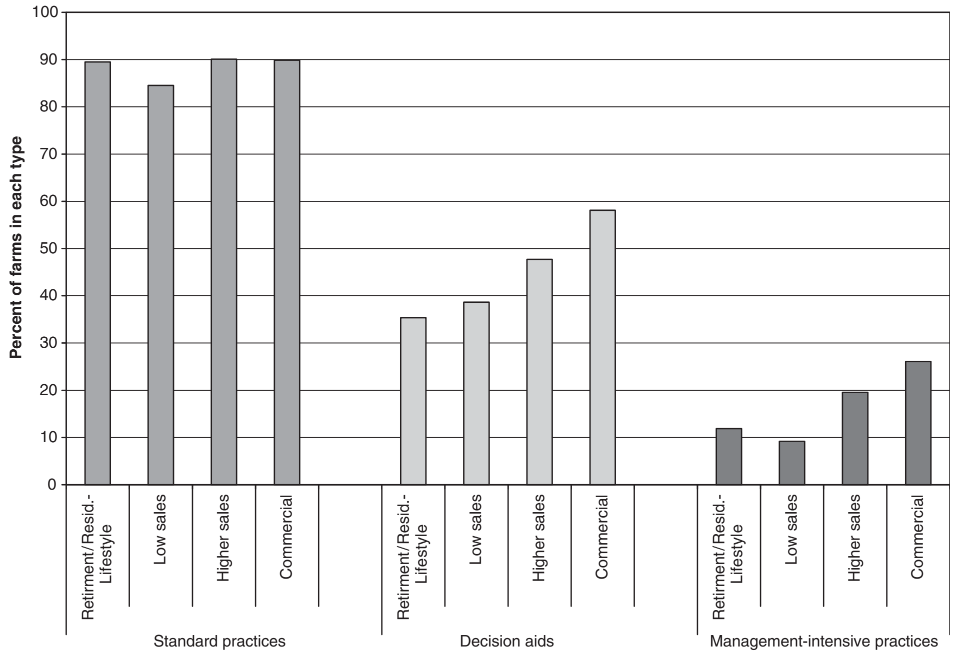

Fig. 4. Conservation management practices used on corn, soybean, and cotton farms, by type of farm, 2001–2003. Non-family farms are excluded. Source: 2001–2003 ARMS, Phase II/III.

WRP, for example). While many of these practices do qualify for reimbursement under EQIP, program funding was limited in 2001–2002, so only about one percent of corn and soybean farms were reimbursed for these (or related) conservation management practices.

Fig. 4 shows the distribution of corn, soybean, and cotton farms that have adopted one or more farming practices in each of the three classes of conservation-compatible management activities. Scale and farm typology do not appear to influence adoption of standard conservation-compatible practices. However, the distributions of farms collecting information to support farming practice decisions and farms using management-intensive conservation-compatible practices suggest that scale and farm typology (that is, occupational farms versus lifestyle or retirement farms) may play a significant role when practices require more farm operator skill or time.

Larger corn farms and farm households with relatively little off-farm income were more likely to employ decision aids and use management-intensive practices (Table 3). Thus, the larger the farm and the more important its profitability is to the farm household's income and well-being (as evidenced by the operator's primary occupation and the farm household's reliance on off-farm income), the more receptive the operator will likely be to practices that potentially reduce costs or increase yields.[13] If these practices cut costs by reducing chemical input use or runoff, they could have broader environmental benefits. While farming practices vary depending on the commodity grown, a similar pattern emerges for soybean and cotton farms (not shown). Corn farm operations tended to be larger than many other family farm operations, averaging 261 hectares compared with 168 hectares operated by the typical family farm in 2001. However, even with a distribution skewed toward full-time farming operations, the effect of scale on farming practice decisions is clear. As the management skill needed to make a farming practice profitable increases, so too does the size of adopting farms (in terms of hectares operated, net farm income, and commodity payments received). While the per-hectare out-of-pocket cost of decision aids and management-intensive practices should not vary much as the size of the farm increases, there may be a steep learning curve to use these practices profitably. (Perhaps reflecting the skills needed to profitably adopt more intensive practices, both the average level of education and reliance on outside consultants increase with management intensity.)

Because of the widespread use of standard practices (for example, crop rotation) that have conservation benefits, relatively few farms had not adopted one or more of the practices examined. The operations were smaller than the "adopting" farms and had lower average yields. Farm operators who did not adopt any of the conservation-compatible practices examined also had fewer years of formal education, relied less on outside consultants, and had lower household income levels.

Results of the cumulative probit regression (Table 4) supplement the univariate findings in Table 3. Larger corn operations were more likely to use decision aids and management-intensive technologies, as evidenced by the positive marginal effect of gross cash income from farming.

[13]While we cannot infer cause and effect, farms that practice more management-intensive farming practices have higher average yields.

Table 3
Farm, operator, and household characteristics of corn farms by the "highest" level of conservation management practices adopted, 2001

Characteristic	Units	Standard practices[a]		Decision aids[b]		Management intensive[c]		No listed practice	
Farm characteristics									
Avg. farm size	Ha	233	BCD	262	ACD	346	ABD	156	ABC
Avg. net farm income	USD[d]	15,390	BC	23,753	A	32,981	AD	17,327[e]	C
Avg. commodity payments	USD	17,409	BCD	24,587	ACD	34,833	ABD	4,561	ABC
Avg. conservation payments	USD	548	D	764	D	761[e]		243[e]	AB
Ha. operated that are owned	Percent	45	D	41	D	43	D	63	ABC
Farms with HEL/wetlands	Percent	20	D	24	CD	17	BD	8[e]	ABC
Irrigated land	Percent	4[e]	C	10[e]		15	AD	3	C
Avg. corn yield	Kg/Ha	7466	BCD	8470	AD	8909	AD	3764	ABC
Operator characteristics									
Avg. Age	Years	53	BC	51	A	51	A	53	
Avg. Experience	Years	27		25		27		26	
Major occupation									
Farming	Percent	69	BC	81	A	84	AD	74	C
Non-farm occupation	Percent	28	BCD	17	A	14	AD	21	AC
Retired	Percent	3[e]		2[f]		3[e]		5[f]	
Education									
High school	Percent	54		48		46		46	
Some college	Percent	20		28		26		21	
Completed college	Percent	13	C	14	C	20	ABD	8[e]C	
Used outside advice[g]	Percent	7	BCD	12	ACD	28	ABD	2[e]	ABC
Household characteristics									
Farm income shared with others	Percent	15		12	D	14		18	B
Off-farm work (operator)	Percent	44	CD	38		31	A	34	A
Off-farm work (spouse)	Percent	48		53	D	46		41	B
Avg. off-farm income	USD	33,176		31,529		30,494		27,582	
Share of HH income off-farm	Percent	70		59		51		62	
Number of observations		484		745		459		142	
Number of corn farms		108,494		141,569		73,963		32,902	
Share of all corn farms	Percent	30		40		21		9	

Notes: Non-family farms are excluded. Coefficient of variation = (standard error/estimate) × 100. Letters A, B, C, and D indicate significant column differences based on *t*-statistics at a 90 percent confidence level or higher. A = standard practices, B = decision aids, C = management-intensive practices, and D = no listed practice. *Source:* 2001 ARMS, Phase II/III.*Source:* 2001 ARMS, Phase II/III.

[a]Farms that use conservation tillage, crop rotation, or insect/herbicide tolerant plants, but do not use other listed practices.

[b]Farms that collect soil or plant tissue tests, systematically scout for pests, or map soil characteristics, but do not use any management-intensive practices.

[c]Farms that use variable rate application of fertilizers and pesticides, rely on soil tests for nitrogen application, or display evidence of integrated pest management practices.

[d]US dollar.

[e]CV is greater than 25 and less than or equal to 50.

[f]CV is above 50.

[g]Farmers who relied on crop consultants or extension service personnel when deciding how much nitrogen to apply.

Farms that combined corn production with the production of high-value crops (fruits, vegetables, and nursery products), poultry, or hogs were more likely to use decision aids or information-intensive technologies. Direct government payments were positively associated with the likelihood that corn-farm operations used more intensive technologies. Corn-farm operators who used advice from consulting services and extension agents and corn-farm operators reporting higher levels of educational attainment were more likely to use decision aids and other management intensive information systems. Operators who irrigated some hectares on their corn farms were also more likely to use decision aids and management-intensive technologies. Operators who organized themselves as family corporations were more likely to use decision aids and management-intensive technologies on their farms, but operators who shared income with other households were less likely to adopt these technologies.

These and the univariate findings are generally consistent with those reported by Caswell et al. (2001) in their analysis of farming practices in the 1990s. They found that farm size, receipt of government commodity program payments,

Table 4
Cumulative probit results for farms growing corn (2001) and management strategies

	Estimate	*T*-test	Marginal effects		
			Standard	Decision aids	Mgt. intensive
Farm structure and production characteristics					
High-value crops	**0.714**	1.87	0.0749	0.0957	0.0001
Grain crops	**0.842**	3.43	0.0883	0.1128	0.0001
Hogs	**0.901**	2.27	0.0945	0.1207	0.0001
Cattle/dairy	−0.051	−0.20	−0.0053	−0.0068	−5.68E-06
Poultry	**0.564**	1.67	0.0592	0.0756	0.0001
Cost/output ratio	−0.0002	−1.47	−2.30E-05	−2.90E-05	−2.44E-08
Income from farming less govt. payments	**0.003**	2.34	0.0003	0.0004	3.19E-07
Tenure	−0.045	−0.34	−0.0047	−0.0060	−5.06E-06
Irrigation (1 = yes)	**0.584**	2.89	0.0613	0.0783	0.0001
Extension/consulting advice (1 = yes)	**0.581**	4.64	0.0610	0.0779	0.0001
Family corporation (1 = yes)	**0.361**	1.93	0.0378	0.0483	4.05E-05
Government assistance					
Conservation payments	0.008	0.65	0.0008	0.0010	8.44E-07
AMTA, LDP, Disaster payments	**0.002**	1.83	0.0002	0.0003	2.22E-07
Household characteristics					
Off-farm Inc./Total HH Inc.	−0.142	−1.14	−0.0149	−0.0191	−1.60E-05
Education experience	**0.116**	2.45	0.0122	0.0156	1.30E-05
Farming experience	0.003	0.23	0.0003	0.0004	3.21E-07
Retired (1 = yes)	−0.256	−0.95	−0.0268	−0.0343	−2.90E-05
Operator works off-farm (1 = yes)	0.040	0.28	0.0042	0.0054	4.53E-06
Spouse works off-farm (1 = yes)	0.100	0.80	0.0105	0.0134	1.12E-05
Dual off-farm income (1 = yes)	−0.076	−0.59	−0.0080	−0.0102	−8.56E-06
Share income with other HH (1 = yes)	**−0.260**	−2.08	−0.0273	−0.0349	−2.90E-05
Environmental variables					
HEL (1 = yes)	0.153	1.60	0.0161	0.0205	1.72E-05
Wetland (1 = yes)	−0.211	−0.71	−0.0221	−0.0283	−2.40E-05
Population density	2.260	0.69	0.2371	0.3028	0.0003
Humidity	0.002	0.23	0.0002	0.0003	2.27E-07
Local/regional economy					
Manufacturing share	−0.772	−1.41	−0.0810	−0.1035	−0.0001
Services share	0.240	0.32	0.0252	0.0322	2.70E-05
Wholesale/retail share	1.387	1.26	0.1456	0.1859	0.0002
Sample size (*N*)[a]			477	600	364
Expanded farm population			115,151	107,536	58,734
Log likelihood	−355,986				

Notes: Entries in **BOLD** are significant at the 10% level or lower. *Source:* ARMS 2001 Phase II.
[a]Farms not using conservation-compatible practices: $N = 139$, expanded farm population = 32,285. Numbers do not match exactly with Table 3 because of missing values of some variables used in the regression.

use of expert advice, educational attainment, and use of irrigation systems were often related with the decision to adopt "modern" farming practices (which loosely correspond to our "management-intensive" conservation practices).

Use of conservation structures

In addition to adopting conservation-compatible practices on working-land, farm operators can also install conservation structures on working and retired farmland. Fig. 5 shows the percentages of all farms that installed conservation structures on their farms or rotated fields out of production in 2001.[14] As expected, scale is important when the conservation structure is compatible with ongoing farming operations (for example, grass waterways and filters, contour strips, and riparian buffers) but is less important when practices involve land retirement and

[14]The question on whole fields planted to grasses, etc. does not require the respondent to differentiate between cropland and pastureland and between "permanently" retired fields and fields left temporarily fallow or planted to grasses/legumes as part of a planned crop rotation. For farms participating in CRP, land is retired for a multiyear contract period and is managed for conservation purposes, but for others, land could come back into production at any time (or may currently be working pastureland) and so may have only limited environmental benefits.

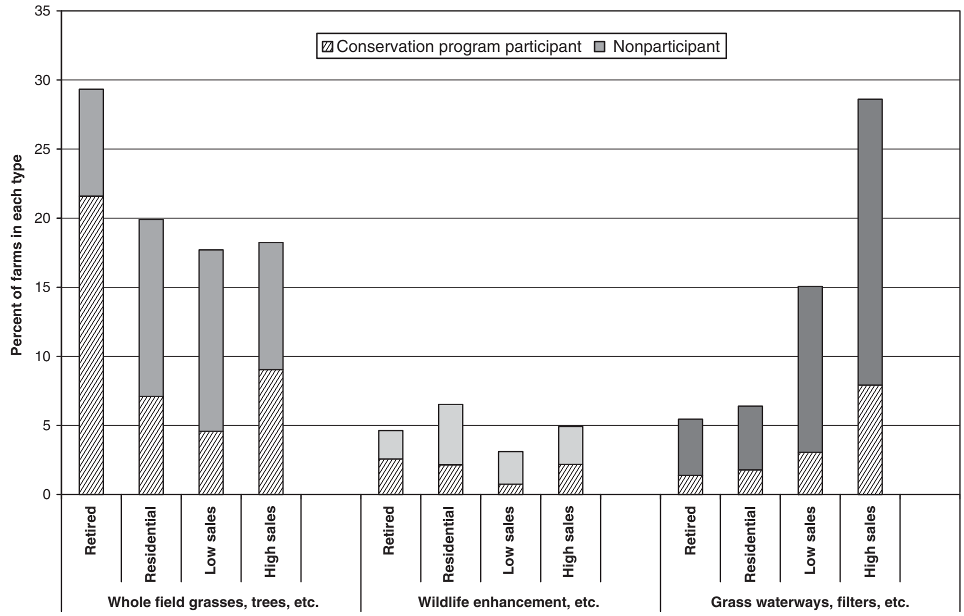

Fig. 5. Conservation structural and vegetative practices on all family farms with and without conservation program funding, by type of farm, 2001. Notes: The shaded portion of each bar represents farms that have conservation structures in place and that currently receive conservation funding. The program funding need not be for the specific practice highlighted. Whole fields planted to grasses, etc. which are obviously pastureland, are excluded, but this category may include land never intended for crop production and cropland left fallow on a temporary basis. Source: 2001 ARMS, Phase III, Version 1.

wildlife enhancement. Furthermore, participation in a conservation program was higher among farms planting whole fields to grasses, etc. and installing wildlife enhancements than it was for working-land conservation structures.

Table 5 presents descriptive statistics on the business, operator, and household characteristics of farms that installed conservation structures and those that did not. Most family farms had none of the identified structures in place in 2001. Of the 25 percent that had one or more conservation structures, over half were in the form of whole fields planted to grasses, legumes, or trees. Working-land conservation structures accounted for another one-third of "practising" farms. Major differences between farms that did not install conservation practices were largely restricted to the working-land structures. The significant differences between non-installers and farms that retired whole fields to vegetative cover were the lower percentage of retired farm operators, the lower level of conservation payments, and the higher proportion growing high-valued crops among non-installers.[15]

There were a number of significant differences between farms that "retired" whole fields and those that installed grass waterways, filter strips, and other structures compatible with working-land. Farms that installed the latter were larger grain farms that rely less on conservation payments. The farm operator was more likely to consider farming his/her primary occupation, was slightly younger, and relied less on off-farm income than farm households that participated in land retirement programs. These differences are consistent with the previous finding that farm operators focused on farm production and relatively more reliant on farm income were more likely to invest in relatively costly and management-intensive conservation practices.

The univariate results of Table 5 are supplemented by the results of the multinomial logit regression (Table 6). Farms concentrating on grain production were more likely to install working-land conservation structures. Farms using land susceptible to water erosion or near water sources (streams, rivers, etc.) were more likely to install working-land conservation structures. Apparently, these factors weigh more heavily in the decision to install various conservation structures than operator characteristics, holding other factors constant.

Discussion

There are significant differences in the adoption of conservation practices that embody knowledge and skill within the technology itself (such as insect and herbicide tolerant plants) and the adoption of practices that require farm operator knowledge and skill (such as variable rate application of inputs). Farm conservation practices requiring relatively little specialized management skills and costing the farm operator little in foregone profits or out-of-pocket expenses are widely dispersed among the farming population. Their adoption may have environmental benefits, but the farm operator's primary consideration is

[15]An exhaustive list of conservation structures eligible for reimbursement under CRP or EQIP is not included. As a result, the "No listed practice" group includes farms that receive conservation payments for other activities.

Table 5
Farm, operator, and household characteristics of farms that have selected conservation structures in place, 2001

Characteristic	Units	Whole field grasses, etc.		Wildlife enhancement		Working lands[a]		No listed practice	
Farm characteristics									
Avg. farm size	Ha.	200		285[b]		240[b]		157	
Avg. net farm income	USD[c]	14,844[d]		7308[d]		30,877[b]	D	12,033[b]	C
Avg. commodity payments	USD	5352	C	6648[b]	C	19,427	ABD	5689	C
Avg. conservation payments	USD	3043[b]	CD	3258[b]	CD	711	ABD	189[b]	ABC
Avg. share of production from									
Grains	Percent	10	C	14[b]	C	47	ABD	12	C
High-value crops	Percent	2[d]	BD	9[b]	AC	2[d]	BD	8[b]	AC
Livestock	Percent	36		24[e]		36		43	
Other	Percent	17		32[e]		9[b]	D	22	C
Operator characteristics									
Avg. age	Years	58	C	54		53	A	54	
Avg. experience	Years	24		22[b]		26		22	
Major occupation									
Farming	Percent	35	C	29[e]	C	68	ABD	40	C
Non-farm occupation	Percent	41		58[b]		26[b]	D	50	C
Retired	Percent	25	CD	12[b]		6[b]	A	10[b]	A
Education									
High school	Percent	42		29[b]		43		41	
Some college	Percent	21		34[d]		27		24	
Completed college	Percent	14[b]		18[d]		13		13	
Female operator	Percent	17[b]	C	9[d]		3[b]	AD	8	C
Household characteristics									
Avg. size of household (HH)	Number	2.6		2.9		3.1		2.7	
Farm income shared with others	Percent	4[d]		—		5	D	2[e]	C
Off-farm work (operator only)	Percent	17[b]		21[d]		19		24[b]	
Off-farm work (spouse only)	Percent	15[e]		8[b]	C	22	B	13	
Off-farm work (dual)	Percent	34		48[b]		31		32	
Avg. off-farm income	USD	52,811		77,778[b]		44,192	D	60,499	C
Share of HH income off-farm	Percent	83		88	C	74	BD	83	C
Number of observations		546		223		488		4090	
Number of farms		263,553		82,322		166,863		1,499,219	
Share of all farms	Percent	13		4		8		75	

Notes: Non-family farms are excluded. Coefficient of variation (CV) = (standard error/estimate) × 100. Letters A, B, C, and D indicate significant column differences based on *t*-statistics at a 90-percent confidence level or higher. A = whole field grasses, etc., B = wildlife enhancement, C = working-land practices (grass waterways, filter strips, etc.), and D = no listed practice. —indicates legal disclosure problems. *Source:* 2001 ARMS, CRR version 1.

[a]Conservation structures consistent with farm production, such as grass waterways, filters, and riparian buffers.

[b]CV is greater than 25 and less than or equal to 50.

[c]US dollars.

[d]CV is above 75.

[e]CV is greater than 50 and less than or equal to 75.

cost (time) minimization. Farm practices that require more intensive management skills and considerable investment in working capital appeal more to farm operators concerned with maximizing farm profits. Large-scale farm operations can spread the cost of such practices over more hectares, making it easier to justify the initial investment in equipment and management skill. For example, contour farming or strip cropping is much easier using autoguidance steering. These navigating systems are relatively expensive, costing up to 35 thousand dollars (Griffin et al., 2005). Larger operations can more quickly recapture this capital outlay through input cost savings and soil productivity enhancement. Likewise, younger farmers may be more willing to make such investments because of their longer farming horizons. Farm households that depend on farm earnings may also feel pressure to maximize yields by making full use of the farm's resources.

Installation of conservation structures follows a similar logic. Structures that encompass whole fields appeal to farm operators that: (1) have marginal land that cannot be profitably farmed year after year, (2) own pasture not suitable for crop production, or (3) are primarily interested in a goal other than maximizing crop yields. This might be maximizing rental returns (in the form of CRP payments), finding time for other pursuits (such as retirement or an off-farm career), or increasing the value of farmland for

Table 6
Marginal effects of the multinomial logit regression for conservation structures and vegetative cover practices

	WF grasses, trees, etc.	Wildlife enhancement	Working lands
Farm production characteristics			
High value crops	−0.045	0.006	−0.006
Grain crops	**−0.030**	0.000	**0.009**
Hogs	−0.016	−0.027	0.004
Cattle	0.002	−0.004	0.003
Poultry	0.006	−0.009	−0.003
Asset turnover ratio	−0.008	−0.009	0.000
Operation expansion since 1996 (1 = yes)	0.003	−0.002	0.000
Tenure (owned/operated hectares)	0.014	0.005	0.001
Gross cash farm income less govt. payments	0.000	0.000	0.000
Government assistance			
Commodity payments	−0.002	0.002	−0.001
Conservation payments	**0.006**	**0.001**	0.001
Farm household characteristics			
Household size	0.001	0.000	0.001
Farming experience	0.080	0.004	0.013
Education experience	0.002	0.002	−0.002
Off-farm inc./total HH Inc.	0.010	−0.006	−0.004
Female operator (1 = yes)	−0.017	0.002	0.001
Operator works off farm (1 = yes)	−0.001	−0.002	0.002
Spouse works off farm (1 = yes)	−0.008	0.005	0.000
Dual off-farm income (1 = yes)	−0.014	0.000	0.002
Retired (1 = yes)	−0.014	−0.005	−0.001
Spouse raised on farm (1 = yes)	0.029	0.003	0.001
Operator raised on farm (1 = yes)	0.001	0.000	0.001
Environmental characteristics			
HEL (water erosion)	0.041	−0.017	**0.018**
HEL (wind erosion)	0.065	−0.017	−0.008
Humidity index	0.001	0.000	0.000
Farm next to stream, river, lake (1 = yes)	0.023	**0.015**	**0.006**
Distance from nearest town >10,000 persons	0.000	0.000	0.000
Local/regional economy			
Manufacturing	−0.046	−0.028	**0.013**
Service trade	0.033	0.035	0.021
Wholesale/retail trade	0.005	**−0.042**	0.000
Population density (persons/sq. mile)	0.138	−0.072	−0.054
Log likelihood −1,638,676			
Sample size (N)	541	221	483
Expanded farm population	261,866	81,256	165,379

Notes: **Bold** entries are significant at the 10% level or lower. Reference group is non-practicing farms ($N = 4025$ respondents, expanded $N = 1,488,190$ farms). Entries are rounded to three digits. *Source:* ARMS 2001, Phase III, version 1.

non-farm activities (such as hunting, fishing, and scenic enjoyment). Structures that are compatible with continued crop production, such as filter strips, appeal to larger operations that rely more on federal commodity payments than on conservation program payments. Their initial cost and the potential demand on operator management skill when merging such structures into a farm operation make them less suited to smaller operations without significant cost sharing. Thus, the role of conservation programs in influencing conservation practice decisions likely varies by type of practice, the farm's cost structure, the operator's skill, and the household's goals.

Conservation-compatible practices that reduce the operator's time to produce a commodity or reduce out-of-pocket labor and input costs without requiring specialized skills or knowledge have been widely adopted without direct financial assistance from the government. Because of their widespread appeal, the adoption of such practices as conservation tillage, crop rotation, and insect and herbicide tolerant plants have had beneficial impacts on the environment. To the extent that environmental benefits are the goal of conservation efforts, funds to develop the next generation of knowledge-embodied conservation practices (i.e., conservation practices that do not require the farm operator to make a sizeable investment of time or money) might be considered. Development of environmentally friendly plant varieties, farming practices, and inputs, coupled with extension and education, could have broad environmental benefits if they make good stewardship of farmland easier, more profitable, and less risky.

Conservation-compatible practices requiring a sizeable investment of management time or skill are less likely to be adopted by operators of small farms focused primarily on non-farm activities. The financial assistance needed to induce these farm operators to adopt management-intensive conservation practices would likely be high. But, for full-time commercial farm operations, such practices as variable input application rates and integrated pest management can be both profitable and environmentally friendly.

The findings of this research also indicate that the availability of expert advice may help induce the adoption of specialized conservation practices. However, in response to chronic fiscal crises, State funds earmarked for extension are becoming scarce (McDowell, 2004). As a result, many traditional roles played by extension agents are now met by crop consultants. As crop input management decisions become increasingly complex, technical assistance becomes all the more challenging. EQIP currently budgets 23 percent of its funds for technical assistance, part of which goes to non-government technical experts to assist farm operators with conservation practice decisions (USDA, 2003). The findings suggest that technical assistance will remain important if farmers are to make the best use of the growing funds for working-land programs such as EQIP.[16]

Our research also suggests that farm payments may influence the conservation behavior of farmers. The relationship between farm payments and conservation-compatible innovations appears to go beyond satisfying compliance requirements—many farms adopting conservation-compatible practices do not have HEL or wetland that is subject to compliance. By reducing the financial risks of changing farming practices, program payments may make it easier for eligible farmers to introduce such changes.

Conservation practices and structures that do not pay for themselves in reduced costs or increased yields, may require some incentive (positive or negative) for adoption. Voluntary working-land programs could be effective for larger commercial scale farms, especially if combined with technical assistance. Working-land programs could make many of the practices recognized as good conservation behavior affordable. But, the findings presented here also suggest that the cost share needed to make a practice affordable is a function of farm size and the farm operator's plans. If meeting environmental goals requires increased participation in conservation programs, consideration might be given to a sliding scale of payments that accounts for the higher effective cost of conservation practice adoption by smaller farm operations.

Conclusions

With the impending expiration of 80 percent of the 14 million hectares currently enrolled in CRP, policymakers and program managers face important decisions about the future direction of USDA's conservation efforts. By taking a close look at the characteristics of farms, operators, and households that have adopted conservation-compatible practices, with and without Federal conservation program support, this study offers some basic insights into the role of conservation programs in the agricultural sector's conservation efforts. With EQIP augmenting voluntary land retirement programs, the USDA offers farm operators financial assistance for a wide range of conservation programs. In general, working-land and land retirement programs play complementary roles to reduce the environmental consequences of agricultural production. Our research and that of others suggests that, while there is overlap, land retirement and working-land practices are often used by different types of farms.

Land retirement need not signal a retrenchment from production agriculture. Larger farms also retire whole fields.[17] Whether to take marginal land out of production, diversify their operation to include hunting or scenic viewing, address conservation compliance concerns, or reduce variability in farm returns, enrolling one or more fields in CRP may be a logical part of a profit-maximizing farm operation. Roughly half of the participants in the CRP are working farms, so land retirement can be an integral part of a working-land approach to conservation, or a viable strategy to keep the farm working.

While working-land programs have the potential to reach more farms than the traditional land retirement programs can, they are unlikely to appeal to all farm operators and may not provide all of the environmental (particularly wildlife) benefits attributed to USDA's land retirement programs. Smaller farms, particularly those whose operators consider themselves retired or whose primary occupation is something other than farming, are less likely to adopt management-intensive farming practices. They are more likely to adopt conservation-compatible practices that save time and effort and do not require major changes in established practices. But their primary motivation may not be maximizing farm profits, so practices that bolster returns at the cost of added complexity are, ceteris paribus, less likely to be adopted, with or without conservation program financial or

[16]In 2007, EQIP's base funding will be $1.36 billion per year, more than quintuple its original funding allocation (USDA, 2003). If technical assistance funds increase proportionally, they will amount to more than $300 million in the coming years.

[17]Many large farms also use CRP to retire parts of fields, but it is easy to envision these enrollments as being part of a working-land operation. Parts of fields that are not irrigated, are awkward to farm because of terrain, or have poor soils are often left fallow. Farm returns could easily rise if these partial fields were enrolled in the CRP and earned an annual rental payment.

technical assistance. Land retirement is more attractive to retirement and residential/lifestyle farm households than full-time farm households. CRP payments may also stabilize farm income for retired farmers and farmers nearing retirement. In addition, retiring contiguous fields from production can provide a broader array of environmental benefits than is easily accomplished through working-land conservation structures. Wildlife populations, in particular, may require more undisturbed land than is possible through working-land programs.

Finally, it is also important to recognize that varying degrees of environmental benefits can accrue from the adoption of specific conservation practices, depending on the physical characteristics of the farmland. For example, the marginal environmental benefit of adopting conservation tillage on a farm with low soil erodibility is likely to be low, providing little onsite erosion reduction for the farmer or offsite benefit to society.[18]

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