To Adopt Or Not To Adopt:
Conservation Decisions And Participation In Watershed Groups

Wei Hua, Carl Zulauf, Brent Sohngen*
Department of Agricultural, Environmental, and
Development Economics
The Ohio State University
2120 Fyffe Rd.
Columbus, OH 43210

Contact: Hua.22@osu.edu

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* Graduate Research Assistant, McCormick Professor, and Associate Professor, Department of Agricultural, Environmental, and Development Economics, The Ohio State University, Columbus, OH. This research has been supported through a grant from the USDA National Resources Inventory and the McCormick Endowment in AED Economics.

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ABSTRACT

This paper explores how farm programs, watershed groups, and conservation decisions are related. In recent years, watershed groups have become a more important component of the decision process over the allocation of government subsidies focused on environmental improvements, and this research presents one of the first attempts to assess whether watershed groups have had an influence on landowner decisions. Three questions are addressed. First, we explore what factors influence landowner decisions to enter into government conservation programs. Second we consider factors that influence the adoption of conservation tillage. Third, we explore what factors influence farmer decisions to participate in watershed activities occurring near their farms. These questions are addressed with a survey of Ohio farmers conducted during the winter of 2004. The results indicate that watershed groups have had little influence on historically important programs like CRP and conservation tillage adoption, but that they seem to be having a more important influence in more recent programs and state and local programs. The results also indicate that conservation tillage decisions are mainly influenced by age, education, conservation compliance requirements, and attitudes. Owners appear less likely to engage in conservation tillage than renters.

Keywords: conservation program, conservation tillage, watershed group

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INTRODUCTION

Nonpoint source pollution in America's rural watersheds continues to draw attention from policy makers. The last two Farm Bills substantially increased funding for farm environmental programs, and nonpoint source programs at the US and many state Environmental Protection Agencies have increased in size and scope. Concurrently, a trend toward collaborative, community-based natural resource management programs emerged. In particular, a number of watershed groups formed. Their goal has been to build coalitions among individuals interested in solving water quality problems through local efforts. Although the first watershed group dates to1955, 38% of them formed after 1994 and another 28% formed between 1990 and 1994 (Moore and Koontz, 2002). The remaining 34% formed between 1955 and 1989.

Watershed group can play important roles in implementing conservation programs. One is through their involvement and leadership in educational programs. A second is monetary, either through the control of federal or state grants or by providing input to the agencies that decide the practices to fund and/or the regions to target. For example, the last two farm bills granted some decision-making authority to local work groups composed of members from USDA Natural Resource Conservation, Farm Service Agency, Cooperative Extension, and Soil and Water Conservation Districts. These individuals often lead local watershed group efforts.

A sizeable literature exists regarding the factors associated with farmers' adoption of conservation practices and conservation programs (i.e., Ervin and Ervin, 1982; and Soule et al., 2000). However, to our knowledge, only Ervin and Ervin's analysis of conservation practices included a variable related to watershed groups, specifically whether a farmer was located within an organized watershed sub-district. Furthermore, residing in an organized watershed sub-district does not necessarily equate to active participation in a watershed group.

Given that little is known about watershed groups despite their rapid growth and current importance in conservation policy, this study examines their impacts on the adoption of conservation practices and participation in conservation programs. Data for our analysis is obtained from a survey of 1,500 Ohio farm operators conducted during March and April of 2004. Although the results presented in this paper are preliminary, they potentially can help policymakers design and implement more effective policies to address nonpoint source pollution in America's rural watersheds.

The paper is structured as follows. The next section presents a brief review of the literature exploring farmers' conservation decisions. The data, conceptual framework, and empirical results are described in the next three sections. Conclusion and implications are presented in the last section of the paper.

LITERATURE REVIEW

The conservation behavior of farmers has been studied extensively. The adoption and use of soil conservation practices has been an important area of investigation since the 1950s. A seminal study in this area is Ervin and Ervin (1982). They develop an integrated behavioral model that includes physical, economic, personal and institutional factors. They hypothesize a three-stage decision process: (1) identifying erosion as a problem, (2) given stage 1, deciding whether to adopt conservation tillage practices and (3) given stage 2, determining the level of effort when implementing the conservation practices. Multiple regression analysis was used.

Norris and Batie (1987) modify Ervin and Ervin's approach by using a Tobit model. It allows them to combine stages two and three. Norris and Batie use two measures of conservation effort: (1) conservation expenditures and (2) total acres planted using conservation tillage. They find that different factors influence these two measures of conservation effort.

Gould et al. (1989) use a two-limit Tobit model to examine the proportion of acreage planted using conservation tillage. Their results suggest that older operators with smaller farms are more likely to acknowledge that soil erosion is a problem. However, if they perceive that soil erosion is a problem, younger operators with larger operations are more likely to adopt the soil conservation technologies,

Featherstone and Goodwin (1993) investigate the total expenditure on soil conservation by Kansas farmers. They find that older farmers invest less in conservation practices while farmers whose farms are organized as a corporation invest more in conservation practices.

Soule, Tegene and Weibe (2000) explore the adoption of conservation tillage by constructing a two-period model based on McConnell. They assume that farmers choose production practices that maximize the present value of current net returns plus the terminal value of land. They find that tenure status affects how other factors impact the adoption of conservation practices.

Except for Lynne, Shonkwiler, and Rola (1988), studies of conservation practices have not paid attention to attitude toward conservation. They combine economic and psychology theory, and find that conservation decisions are influenced not only by context variables, such as tenure, income and farm terrain, but also by attitudes.

Ever since the authorization of the Conservation Reserve Program (CRP) in 1985, participation in voluntary conservation programs has attracted substantial research. Force and

Bill (1989) relate adoption of CRP to a range of socioeconomic and attitudinal factors. Their analysis of farmland data from New York finds that, compared with non-participating farmers, participating farmers owned larger farms, earned non-farm income, used fewer soil conservation practices, and did not milk cows. They also find that attitudes are an important determinant of the participation decision.

Konyar and Osborn (1990) develop a linear random utility model to examine the adoption of CRP. A farmer participates if the expected utility of participation is greater than the expected utility of not participating. Using regional level data for the U.S, they find that the probability of participation decreases with higher land value, larger farm size and age.

Mclean-Meyinsse et al. (1994) explore the relative lack of participation in the CRP by small farmers who have highly erodible cropland. They find that such farmers tend to cite their lack of resources as the reason for not participating. They also find that complaints about low payments tend to occur most frequently among less educated farmers with larger farms and higher average land returns.

CONSERVATION SURVEY DATA

The data for this study are obtained from a stratified, random survey of 1500 farmers in Ohio. The study sought to analyze the conservation behaviors of those farmers who most impact the environment. Thus, the target population was farms with $50,000 or more in sales from farming. According to the *2002 Census of Agriculture*, 18.2 percent of the 77,797 farms in Ohio earned $50,000 or more in farm sales. These farms accounted for 88% of farm sales, 68% of cropland, and 60% of land in farms within the state of Ohio.

Substantial variation occurs in the participation in watershed groups across watersheds. Therefore, to ensure adequate watershed group participation among the survey respondents, 500 names were drawn from within 11 specific watersheds that have a history of active participation by farmers in the watershed group. The remaining sample of 1000farmers was drawn from the rest of Ohio.

The Ohio portion of the NASS (National Agricultural Statistics Service) List Sampling Frame (An extensive sampling frame consisting of the names, addresses, and telephone numbers of producers and agribusinesses, grouped by size and type of unit, which covers all types of farms and accounts for approximately 82% of all land in farms in the U.S.) is classified and used as the sampling frame for the survey (Ohio Agricultural Statistics Service (OASS)).

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The survey was mailed on March 12, 2004. A post card reminder was sent one week later. Telephone interviews began on March 30 with producers who had not responded to the mail survey. By the date of this analysis, responses had been obtained from 584 farmers, with 497 of them usable.

ANALYTICAL FRAMEWORK

In this section, the analytical framework is presented for the three integrated decisions being investigated in this paper. The first decision discussed is the commitment to enter into voluntary contracts with the government to produce conservation services. This is referred to as the adoption of conservation programs. It is followed by discussions of the adoption of conservation tillage practices and the involvement in watershed groups.

Adoption of Conservation Programs

We assume that landowners, all of which also are farmers in this study, will accept financial resources for voluntary conservation on their land only if the private benefits plus public financial assistance from adopting the conservation program exceeds the investment cost, i.e. net benefit (NB) is positive. Among the various private and public financial benefits are public rental payments, public cost-share payments, and potential future productivity improvements. In addition, adoption of conservation programs may provide additional environmental utility obtained from non-market benefits resulting from improved environmental conditions (i.e. better hunting or wildlife viewing conditions). On the other hand, adoption costs include not only part or all of the installation and maintenance costs, but also the program transaction time needed to learn about a program, contact the appropriate government agency, fill out the necessary paper work, etc. In addition, farmers lose the real option value of land ownership because conservation programs restrict how enrolled land can be used.

The net benefits derived from adopting a conservation program are modeled as a latent variable, which is a linear function of the matrix of explanatory variables, X :

(1) $NB_i = X_i\beta + \varepsilon_i$, where $\varepsilon_i \sim N(0,\sigma^2)$ and i=1,2,…n.

Let Y_i be the indicator variable, so that

$$(2) \qquad Y_i = \begin{cases} 1 & if \quad NB_i > 0 \quad (adoption) \\ 0 & if \quad NB_i \le 0\,(nonadoption) \end{cases}$$

The probability of adoption is given as:

$$(3) \qquad \Pr(Y_i = 1) = \Pr(NB_i > 0) = \Pr(\varepsilon_i < \mathrm{X_i}\beta) = \Phi(X_i\beta),$$

where $\Phi(X_i\beta)$ depends on the explanatory variables. Given the dichotomous nature of the participation decision, Probit econometric techniques are used in the empirical investigation of the factors associated with the decision to participate in conservation programs.

We also explore the intensity of participation in conservation programs, where intensity is measured as the number of conservation programs in which the farmer participates. Our data indicate that a large proportion of farmers (approximately 72 percent) do not participate in federal or state voluntary incentive programs at all, 22.5 percent obtain funding from one program, 4.5 percent obtain funding from two programs, and only 1 percent participates in more than two programs. We want to examine what factors influence a farmer's decisions to enter into more than one program.

The number of programs in which a farmer participates is modeled as a Poisson process. Specifically, the number of programs (y_i) is modeled as a random draw from a Poisson distribution with a mean (λ_i), which is assumed to be a function of a vector of parameters (β) and a vector of explanatory variables (X_i). The probability density function of y_i is

$$(4) \qquad f(y_i) = \frac{e^{-\lambda_i}\lambda_i^{y_i}}{y_i!} \quad y_i = 0, 1, 2, 3, \ldots$$

where the functional from of λ_i is assumed to be $\lambda_i = e^{X_i\beta}$.

Adoption of Conservation Practices

Farmers may engage in conservation practices without receiving any government payments. Thus, it is important to examine what factors influence overall conservation decisions on farms. Our survey provides information about different types of conservation decisions, for this paper we focus on the adoption of conservation tillage. Future studies will examine the adoption of other conservation practices. Conservation tillage is defined as any tillage and planting system that covers 30 percent or more of the soil surface with crop residue, after planting (Conservation Technology InformationCenter (CTIC)).

A farmer's choice of conservation tillage is assumed to depend on weighing the benefits and costs. Benefits of conservation tillage include not only the control of soil erosion and the associated reduction in water pollution, but also the cost savings resulting from smaller time, fuel and labor costs in the field. On the other hand, a farmer may have to rent or purchase new equipment and must learn how to best manage the new system. Furthermore, the evidence from agronomic trails is that the impact of conservation tillage on yields and returns varies by soil type and other agronomic characteristics. Our data indicate that 69% of farmers adopt conservation tillage and among those 69% farmers, on average, 68% of their total planted acreage is covered by conservation tillage.

For this paper, we follow Gould et al.'s (1989) approach. Our measure of a farmer's conservation effort, designated y_i^*, is the proportion of land in conservation tillage. Because the distribution of a proportion is censured at both its lower (i.e., 0) and upper (i.e, 1) ends, a Tobit model is used. Thus, y_i^* is a latent variable. It is a linear function of the matrix of explanatory variables, X_i:

(5) $y_i^* = X_i\beta + \varepsilon_i$, $\varepsilon_i \sim N(0,\sigma^2)$ and i=1,2,…n.

The decision rule is

$$(6) \qquad y_i = \begin{cases} 0 & if \quad y_i^* \le 0 \\ y_i^* & if \quad 0 < y_i^* < 1 \\ 1 & if \quad y_i^* \ge 1 \end{cases}$$

Please note that this model does not strictly constrain the dependent variable to lie between 0 and 1. In the future, alternative approaches will be used to more carefully model this decision.

Conservation Decisions and Watershed Group Participation

To our knowledge no study has assessed whether participation in watershed groups influences a farmer's decision to adopt conservation programs and practices. As with the other voluntary behaviors described above, we assume that participation in watershed groups will occur only if the perceived net benefit of participation is positive, i.e. benefits outweigh the costs.

Twenty percent of the Ohio farmers who responded to the survey participated in watershed group activities. These participants noted the following benefits, along with the share of participants mentioning it: greater personal awareness of how soil erosion impacts water quality (60%), greater personal awareness of soil erosion problems (55%), information about cost-share programs (53%), additional funds for adopting conservation practices (35%), and volunteer help in establishing conservation practices on their farm (20%). These findings underscore the important role watershed groups play in promoting conservation programs and practices. In addition, over 50% of the participants gained satisfaction from improving awareness among non-farmers about farmer's conservation efforts. This finding suggests that farmers who place a greater value on the environment will be more likely to participate in watershed groups.

Potential costs of participating in watershed group include the time devoted to meetings and volunteer activities, as well as membership fees and monetary donations. It is reasonable to expect that farmers who have a higher opportunity cost of time may be less likely to participate.

In general, different farmers will weight the various benefits and costs differently, thus leading to different decisions. A farmer's perceived benefit (B) is a function of a set of explanatory variables (X_1). His or her perceived cost (C) is a function of another set of explanatory variables (X_2). X_2 may include the same or different variables as X_1. These equations can be written as:

(7) $B_i = \beta_1 X_{1i} + v_{1i}$, $v_1 \sim N(0, \sigma_1^{\,2})$

(8) $C_i = \beta_2 X_{2i} + v_{2i}$, $v_2 \sim N(0, \sigma_2^{\,2})$ and i=1,2,…n.

where β_1 and β_2 are vector of parameters and v_1 and v_2 are i.i.d. error terms which are assumed to be normally distributed.

The net benefit of participation (NB_i) can be expressed as:

(9) $NB_i = B_i - C_i = (\beta_1 X_{1i} - \beta_2 X_{2i}) + (v_{1i} - v_{2i}) = \beta X_i + \varepsilon_i$,

where $\varepsilon_i = v_{1i} - v_{2i}$ and $\varepsilon_i \sim N(0, \sigma_\varepsilon^{\,2})$ and β and X are the set of all parameters and all explanatory variables, respectively.

Let y_i be the indicator variable for a farmer's participation decision; y_i equals one if the farmer participates in a watershed group and zero otherwise. Therefore, probability of participation is given as:

(10) $P(y_i = 1) = P(NB_i > 0) = P(\beta X_i > -\varepsilon_i) = F(\beta X_i)$, where $F(.)$ is the cumulative density function of the normally distributed error term ε. Given this conceptual framework, a Probit model is used to assess this decision process.

RESULTS

Descriptions and summary statistics for the variables used in this analysis are presented in table 1. Given that our sample is limited to farms with gross revenue over $50,000, it is not surprising that the average farm size of respondents is 635 acres, which is substantially higher than the average Ohio farm size of 187 acres reported in the 2002 *Census of Agriculture*. The Census reports a 618 acres average farm size for farms with sales in excess of $50,000. Sample respondents own 53 percent of the land they farm. This compares with an owned acreage share of 41 percent from the 2002 Census for farms with sales in excess of $50,000. Fifty-nine percent are older than 50, and 31 percent are older than 60. This compares with the following numbers from the *Census of Agriculture:* 53% and 27%. Thus, it appears that larger farms, owned land and older farmers are slightly over represented among sample respondents.

Forty seven percent of the survey respondents had attended college, and 44 percent had an off farm job. Nearly 70 percent of the Ohio farmer respondents used conservation tillage in 2003, but conservation tillage was used on only about half of the land that they planted in 2003. Slightly over one-quarter of the respondents had ever entered into conservation contracts with the government. One-fifth reported that they had participated in at least one watershed group activity at some time in the past. Results from the empirical estimates of the models described above are now discussed.

Conservation Programs Adoption

Results for the Probit adoption model of conservation program[1] (i.e., whether or not the farmer had ever participated in any conservation programs) are presented in columns 1 and 2 of Table 2. Results for the Poisson model of number of programs adopted are presented in columns 3 and 4. In both models, most of the age and education variables are insignificant. Previous studies have found either no relationship between age and participations (Mclean-Meyinsse et al., 1994; Gyawali et al., 2003) or a negative relationship (Konyar and Osborn, 1990; Kingsbury and Boggess, 1999). The relationship between education and participation is also ambiguous in the literature, some find no relationship (Mclean-Meyinsse et.al., 1994), some find positive relationship (Gyawali et al., 2003), and some find negative relationship (Kingsbury and Boggess 1999).

An off farm job may increase the opportunity cost of the transaction time needed to learn about and enroll in conservation programs. An off-farm job also could indicate the need for additional income. This need is expected to reduce the willingness to adopt conservation programs because conservation programs often cover only a portion of adoption costs. As expected, the coefficient of the off-farm job variable is negative in both equations, but the coefficient is significant only in the Probit adoption equation.

Everything else equal, farms with larger acreage of owned and rented land are more likely to have land that meets the erosion potential or other eligibility conditions for conservation programs. This measure of farm size is not significant in the Probit adoption model, but is positive and significant in the Poisson number of programs adopted model.

[1] The conservation programs listed in the survey are Conservation Reserve Program, Conservation Reserve Enhancement Program, Wetlands Reserve Program, Environmental Quality Incentive Program, Forestland Incentive Program, State Programs (Natureworks or USEPA section 319 programs), and Other Fed, State, Local programs.

We expect that tenure insecurity gives renters little incentive to maintain soil fertility or control erosion. Thus, owner-operators are more likely than renters to adopt conservation practices. Furthermore, the decision to enter rented land in a conservation program rests either with the owner or is a joint decision of the owner and renter. Because of these transaction cost considerations, we expect that owned land may be more likely to be entered into conservation programs. As hypothesized, land tenure, or the proportion of total acres owned by the farmer, is positively related to adoption of conservation programs. However, it is significant only in the Probit adoption model.

Although the 2002 Farm Bill has changed this distribution, historically a greater number of conservation programs and program dollars have been available for field crops. Thus, we expect the share of farm sales from livestock and the share from high value crops, such as fruits and vegetables, to be inversely related to the adoption of farm conservation programs. Neither variable is significant in either model. Three of the four signs are negative. The exception is the share of sales from livestock in the number of programs adopted analysis.

Enacted in the *Farm Security Act of 1985*, Conservation Compliance denies certain farm program benefits, including support payments, to farmers who convert a wetland into cropland or who farm highly erodible land without an approved conservation plan. (Zulauf et al.). We expect that being subject to Conservation Compliance on owned land will increase the incentive to adopt conservation program in order to help meet the requirements of approved, written conservation compliance plans. As expected, farmers subject to Conservation Compliance are more likely at the one percent level of statistical significance to adopt conservation programs, and they adopt a larger number of programs.

A farmer's preference for the disposition of the farm upon retirement has been examined in studies of conservation practices, but not in studies of conservation programs. The accepted argument in the conservation practice literature is that farmers who intend to leave the farm to children are more likely to adopt conservation practices. To examine this relationship for the adopting of conservation programs, two dummy variables are created. One reflects an uncertain outlook regarding what will happen to the farm. The second is the expected transfer of the farm to someone other than the farmer's own children. Uncertainty is positively and significantly related to the number of conservation programs adopted, but is insignificant in the Probit model. The other variable is not significant in either model.

Studies have found that attitudes significantly impact the decision to participate in conservation programs (Force and Bill, 1989; Kingsbury and Boggess, 1999). Attitude questions included in the survey were measured using a Likurd scale that varied from 1 (strongly agree) to 5 (strongly disagree). All attitude questions were scored so that they are expected to have a negative relationship with the dependent variable.

Attitude questions included in the conservation program equations are (1) "Soil erosion is a major problem on my farm" (designated erosion1), (2) "Farmers should reduce soil erosion on their land" (designated erosion2), (3) "Farming is a major source of water pollution in Ohio" (designated water1), (4) "Government should regulate farming practices to improve water quality" (designated government1), and (5) "Government should pay farmers for adopting conservation practices" (designated government2). Both water1 and government2 are statistically significant at the 5 percent level in both equations. Erosion2 was statistically significant at the 5 percent level in the Poisson analysis. These results confirm the important role that attitudes can play in determining whether or not a farmer decides to participate in conservation programs.

Use of conservation tillage by a farmer was positively and significantly related to both the Probit and Poisson model of conservation program adoption. This positive relationship contrasts with negative relationship found by Force and Bills between number of conservation practices used and participation in the Conservation Reserve Program. A positive and significant relationship also exists between adoption of conservation programs and the use of a conservation structure[2] in 2003. Participation in watershed group was insignificant in the Probit conservation program adoption model, but was positively and significantly related to the Poisson conservation program adoption model.

Conservation Tillage Intensity

In general, the same explanatory variables are used in both the conservation tillage intensity model and the conservation program models (Table 3). The primary exception is the use of different attitude variables. The attitude factors influencing conservation tillage decisions are expected to differ from the attitude factors influencing the adoption of conservation program decisions.

Farmers under the age of 50 have a greater share of their land in conservation tillage than farmers over 60. This result implies that adoption of conservation tillage is inversely related to age. Education positively influences intensity of conservation tillage adoption. In particular, college education appears to make the farmers likely to adopt conservation tillage on more of their land.

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[2] The list of conservation structures in the survey is grass waterway, grass filter strip, wooded filter strip, wetland restoration/conservation, and contouring/strip cropping/terraces.

Total number of acres farms, off-farm employment, and expected disposition of the farm upon retirement were not significantly related to the share of acres on which conservation tillage was used. As expected, share of farm sales accounted for by livestock were negatively associated with the share of acres on which conservation tillage was used. Almost all farmers livestock in Ohio spread the manure on their cropland to fertilize the land. No-till operations essentially preclude the incorporation of manure, making it less likely for livestock producers to use conservation tillage. Because of the greater potential for fungus infestation when crop residue is left on the soil or the nature of the production process, as in growing fruit trees; no-tillage is typically not used in the production of high-value crops.

Many studies have examined the relationship between land tenure and conservation practice. Conflicting empirical evidence and competing conceptual arguments exist. One common conceptual argument is that, because of tenure insecurity, renters have little incentive to maintain soil fertility or control erosion. Consistent with this argument, many studies have found that owner-operators are more likely than renters to adopt conservation practices (for example, Ervin, 1982; Norris and Batie, 1987; Lynne and Rola, 1988; Featherstone and Goodwin 1993). On the other hand, Lee and Stewart (1983) argue that rental arrangements usually should not pose significant obstacles to the adoption of minimum tillage. Norris and Batie (1987) hypothesize a positive relationship between share of rented land and acres in conservation tillage, but their results fail to support this hypothesis. Soule et al.'s (2000) findings suggest that renters are more likely to adopt conservation tillage on highly erodible land. Our results support the arguments and findings in these last three papers: as the share of owned land increases, the share of land that is conservation tilled decreases.

Few studies have examined the effect of Conservation Compliance on conservation tillage. An exception is Norris and Batie (1987). They found out that having a conservation plan did not influence the total acres planted using minimum tillage or no-tillage, but did influence positively expenditures on other conservation practices. Our results show that landowners with a written Conservation Compliance plan use conservation tillage more intensively. This finding suggests that Conservation Compliance promotes the use of conservation tillage.

Attitude questions included in the conservation tillage analysis are (1) "Soil erosion is a major problem on my farm" (designated erosion1), (2) "Soil erosion is a major source of water pollution in Ohio" (designated erosion3), (3) "Adoption of no-till increases yields and reduces production costs enough to pay for the cost of adopting no-till" (designated no-till1), (4) "Adoption of no-till increases year-to-year variation in farm returns" (designated no-till2), and (5) "I will adopt conservation practices if people important to me think adoption of these practices is the right decision" (designated social norm).

Unsurprisingly, those farmers who believed that adoption of no-till is profitable (i.e., no-till1) used conservation practices on a higher proportion of their land. This variable was significant at the 1 percent level. No-till2 was significant at the 10 percent level. Its negative coefficient implies that a belief that no-till increases annual income risk is associated with using no till on a smaller share of a farmer's acres. Interestingly, erosion1 is insignificant, while erosion3 is significant at the 10 percent test level. Thus, the use of conservation tillage is associated with the perception that soil erosion is a problem for the state of Ohio but not with the perception that soil erosion is a problem on the operator's own farm. Further complicating the picture regarding the role played by attitudes is the insignificance of social norm. In other words, farmers did not indicate that they would be more likely to adopt conservation practices if people important to them thought adoption of conservation practices was the right decision.

Unexpectedly, the dummy variables for conservation program participation and watershed group participation are insignificant. This finding implies that these two behaviors are not associated with the share of farmland on which conservation tillage is used.

Watershed Group Participation

Table 4 contains the Probit regression results for participation in watershed group activities. The measurement of watershed group participation is whether a farmer has ever participated in activates sponsored by a watershed group. Farmers age 60 and older were more likely to participate in watershed groups than either farmers between the ages of 40 and 49 and between the ages of 50 and 59. Statistical significance is at the 1 percent level for the 40 to 49 year old farmers and at the 10 percent level for the 50 to 59 year old farmers. However, because no significant difference existed in the watershed participation of farmers younger than 40 and farmers older than 59, it is difficult to develop a coherent explanation for the observed relationship between age and participation in watersheds.

Similar to the results for the analysis of the use of conservation tillage adoption, farmers with college education have a higher participation rate in watershed groups. However, college education was not a significant factor in explaining participation in conservation programs. These mixed results preclude the drawing of a conclusion between college education and the adoption of conservation decisions.

Number of acres farmed is positively associated with participation in a watershed group at the 1 percent significance level. This finding is consistent with Hua and Sohngen's (2002) analysis. One explanation for this finding is that larger farms are more likely to be contacted by watershed groups because of the more visible presence their farming operation has in the watershed. Farmers with larger operations also may be more willing to participate in a local watershed group because of the potential impact that the watershed group may have on their operation.

Among the different variables associated with type of operation, only livestock intensity is significantly associated with watershed group participation. Farmers who are more dependent on livestock are more likely to participate. This result is consistent with Hua and Sohngen's (2002) finding that individuals who have cattle in addition to row crops are more likely to join watershed groups. These findings are not surprising because, over the last few years substantial effort has been placed on developing rules for livestock operations.

Attitude questions included in the analysis of watershed participation are (1) "Water is an important resource that needs to be protected" (designated water2), (2) "Water pollution is a major problem in my area" (designated water3), and (3) "Farmers have a responsibility to society to reduce the causes of water pollution that originate on their farms" (designated responsibility). Farmers who believed that water was a resource that needs to be protected and that farmers had a responsibility to society to reduce water pollution on their farms were statistically more likely to participate in watershed group. The level of significance of these variables was 10 percent.

The dummy variable was coded on whether (value of 1) or not (value of 0) a farmer was located in 1 of the 11 watersheds stratified for sampling purposes. This variable was related to participation in a watershed group at the 10 percent level of significance. Its positive coefficient implies that those farmers located in a watershed known to have an active watershed group for an extended period of time were more likely to participate in the watershed group. This finding underscores the importance of generating sustained visibility on the part of a watershed group if it wishes to attract farmers as members.

The coefficient on the dummy variable for conservation program adoption is positive and significant. However, the dummy variable for conservation tillage adoption has no statistically significant relationship with participation in a watershed group.

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

Over the last 10 to 15 years, the number and importance of watershed groups in the farm environmental policy area have grown substantially. They both play an educational role and help allocate environmental payments. Given their expanding role, it is useful to consider whether participation in watershed groups influence a farmer's decisions regarding conservation, specifically participation in public conservation programs and the use of conservation tillage. These decisions are assessed using data collected by a recent stratified, random survey of 1,500 Ohio farmers with over $50,000 in farm sales. A total of 497 useable responses were received.

About 27% of the Ohio farm operator respondents have participated in conservation programs, with about 5% participating in 2 or more programs. Nearly 70 percent used conservation tillage in 2003. On average, the respondents used conservation tillage on 48 percent of their farmland in 2003. Participation in watershed group activities varied substantially across the 11 different watersheds sampled, ranging from zero to thirty-five percent. Statewide, 20 percent of farmers had participated in at least one watershed group activity at some time in the past.

Our empirical analysis suggests that participating in watershed groups can influence the number of conservation programs adopted. Further, participation in conservation programs appears to positively influence participation in watershed group activities. These finding suggest that participation in conservation programs and watershed groups should be modeled as a simultaneous decision on the part of the farmer.

The share of farm land on which a farmer uses conservation tillage was positively and significantly related to the farmer's adoption of conservation programs. However, the intensity with which a farmer uses conservation tillage is not associated with the farmer's adoption of conservation programs. This finding is consistent with the argument that watershed groups typically do not focus on farm productivity, but instead have worked to expand the focus of the Natural Resource Conservation Service on environmental issues such as nutrient loadings and pesticide run-off. Combining the two results discussed in this paragraph suggests that a recursive relationship exists between the adoption of conservation program and the use of conservation tillage.

Perhaps not surprisingly, one of the strongest explanatory variables in the regression analyzes s is conservation compliance. That is, individuals who have written and approved conservation compliance plans in place are more likely to have adopted conservation programs and to use conservation tillage more intensively. This appears to have been one of the most effective components of earlier farm bill legislation in terms of moving farmers towards adopting conservation programs and practices, although we cannot state for certain how many farmers should have adopted compliance plans but did not.

As with many other studies, attitudes also play a strong role in the adoption of conservation programs and conservation tillage. Also, it is not surprising that the share of farm sales derived from livestock is significantly and negatively related to the use of conservation tillage. This makes sense given that operators of livestock farms usually need to incorporate manure into their fields, leading to the need to plow.

These results, while interesting, are a first step in analyzing the dataset. Additional analysis will be conducted to more fully explore the relationships described above. Several analytical issues will be addressed. First, a measure of the intensity of participation in watershed groups need to constructed. This measure will utilize information available from the survey, including whether the farmer is a member, use of the farm for demonstrations, attendance at meetings, contributions, and length of membership. Second, factor analysis will be used to construct an index of attitude factors, rather than using single attitude question. This procedure will increase the precision with which attitudes are measured. Third, a Multinomial Logit model will be used instead of a Tobit model to examine conservation tillage intensity. The Multinomial Logit Model is more consistent with what we believe to be the underlining decision-making process. Last, the interrelationships found among participation in conservation programs, use of conservation tillage, and participation in watershed group activities implies the need for simultaneous estimation in order to capture the endogeneity among them. This will involve innovation in econometric methods because Probit, Poisson, and Multinominal Logit models will be estimated simultaneously.

Table 1. Description of Variables Obtained from Surveyed Farmers, Ohio, 2004.

Variable	Mean	Std Dev	Min	Max	Description
Conserv. Prog. – partic	0.27	0.44	0	1	1= Participated in any conservation program, 0=otherwise
Conserv. Prog. – nos.	0.34	0.69	0	7	Number of conservation programs participated in
Conserv. Till - share	0.48	0.39	0	1	Share of planted acres conservation tilled in 2003
Watershed Group	0.20	0.40	0	1	1=Participated in watershed group activities, 0=otherwise
Age < 40	0.11	0.31	0	1	1=farmer's age is less than 40; 0=otherwise
Age 40 – 50	0.30	0.46	0	1	1=farmer's age is between 40 and 49; 0=otherwise
Age 50 – 60	0.28	0.45	0	1	1=farmer's age is between 50 and 59; 0=otherwise
Educ. – high school	0.53	0.50	0	1	1=high school graduate or GED; 0=otherwise
Educ. – some college	0.35	0.48	0	1	1=some college education; 0=otherwise
Work Off-Farm	0.44	0.50	0	1	1= farmer worked off farm in 2003, 0=otherwise
Total Acres	635	669.84	3	5532	Total owned and rented (cash and share rent) acres
Animal Sales Share	0.30	0.004	0	1	Percent of annual gross farm sales from animals in a normal year (Sum of the dairy, beef, hogs, poultry and sheep)
High Value Crop Share	0.03	0.002	0	1	Percent of annual gross farm sales from high-value crops in a normal year (Sum of vegetables, fruit, horticultural and greenhouse crops)
Owned Acres Share	0.53	0.36	0	1	Share of Total Acres Owned
Transfer – uncertain	0.41	0.49	0	1	1=uncertain about what happens to farm when the farmer retires
Transfer – not child	0.16	0.36	0	1	1=Expects not to transfer farm to child (includes transfer to relative, transfer to non-relative, convert to non-farm use, sell development rights, donate to farmland preservation programs)
Conserv. Till – 2003	0.69	0.46	0	1	1=Conservation tillage used on operated land (owned and rented) in 2003, 0=otherwise
Conserv. Struct. 2003	0.35	0.48	0	1	1= Conservation structure on operated land (owned or rented) in 2003, 0=otherwise
Conserv. Compliance	0.43	0.50	0	1	1=written conservation plan approved by NRCS for HEL on owned land; 0=otherwise
Attitude – erosion1*	3.59	0.93	1	5	"Soil erosion is a major problem on my farm."
Attitude – erosion2*	1.95	0.57	1	5	"Farmers should reduce soil erosion on their land."
Attitude – erosion3*	2.73	0.91	1	5	"Soil erosion is a major source of water pollution in Ohio."
Attitude – water1*	3.58	0.84	1	5	"Farming is a major source of water pollution in Ohio."
Attitude – water2*	1.42	0.58	1	5	"Water is an important resource that needs to be protected."
Attitude – water3*	3.45	0.86	1	5	"Water pollution is a major problem in my area."
Attitude – govern't1*	3.64	0.91	1	5	"Government should regulate farming practices to improve water quality."
Attitude – govern't1*	2.62	0.91	1	5	"Government should pay farmers for adopting conservation practices."
Attitude–social norm*	2.80	0.84	1	5	"I will adopt conservation practices if people important to me think adoption of these practices is the right decision."
Attitude–responsible*	2.05	0.70	1	5	"Farmers have a responsibility to society to reduce the causes of water pollution that originate on their farms."
Attitude – no-till1*	2.68	1.02	1	5	"Adoption of no-till increases yields and reduces production costs enough to pay for the costs of adopting no-till."
Attitude – no-till2*	3.19	0.84	1	5	"Adoption of no-till increases year-to-year variation in farm returns."
11_Watersheds	0.35	0.48	0	1	1=Located within the 11 main watersheds in Ohio; 0=otherwise

* Attitude questions were scored on a Likert Scale that ranged from 1 = strongly agree to 5 =strongly disagree

Source: Original data obtained from a survey of Ohio farmers during March and April, 2004.

Table 2. Regression Analysis of Adoption of Conservation Programs, Ohio Farmers, 2004.

	Adopt Conservation Programs		Number of Conservation Programs Adopted	
Variable	**Coefficient**	**Standard Error**	**Coefficient**	**Standard Error**
Constant	-0.0734	0.7575	-0.2303	0.8797
Age < 40	-0.1163	0.3231	-0.2794	0.425
Age 40 – 50	0.4276	0.2230*	0.2112	0.2497
Age 50 – 60	0.2061	0.2149	-0.0745	0.2471
Educ. – high school	-0.1376	0.3103	0.0107	0.4403
Educ. – some college	0.00004	0.3326	0.0726	0.4495
Work Off-Farm	-0.3396	0.1897*	-0.0007	0.2159
Total Acres	0.0002	0.0001	0.0002	0.0001*
Animal Sales Share	-0.2695	0.2682	0.0374	0.3055
High Value Crop Share	-2.6201	1.7901	-0.7163	0.9684
Owned Acres Share	0.6222	0.2847**	0.4798	0.3207
Transfer - uncertain	0.1055	0.1773	0.4006	0.2088*
Transfer – not child	0.0184	0.2532	-0.0065	0.2996
Conserv. Till – 2003	0.5248	0.2322**	0.4816	0.2927*
Conserv. Struct. 2003	0.3935	0.1758**	0.5714	0.1951***
Watershed Group	0.3100	0.2030	0.5562	0.2024***
Conserv. Compliance	0.5022	0.1761***	0.6275	0.2162***
Attitude – erosion1	0.0766	0.0891	-0.0218	0.088
Attitude – erosion2	-0.2279	0.1517	-0.4124	0.1717**
Attitude – water1	-0.2658	0.1034**	-0.2272	0.1111**
Attitude – govern't1	-0.0143	0.0917	-0.1186	0.1012
Attitude – govern't1	-0.2434	0.0927***	-0.2518	0.106**

* significant at 10% level, ** significant at 5% level and ***significant at 1% level

Source: Original analysis based on data from a survey of Ohio farmers during March and April, 2004.

Table 3. Tobit Regression Analysis of Conservation Tillage Adoption, Ohio Farmers, 2004.

Variable	Coefficient	Standard Error
Constant	1.7723	0.2678***
Age < 40	-0.2089	0.1166*
Age 40 – 50	-0.1494	0.0834*
Age 50 – 60	-0.1097	0.0781
Educ. – high school	0.0342	0.1105
Educ. – some college	0.2480	0.1164**
Work Off-Farm	-0.0215	0.0669
Total Acres	.716762D-04	.467427D-04
Animal Sales Share	-0.4261	0.0974***
High Value Crop Share	-1.0362	0.2667***
Owned Acres Share	-0.1724	0.1014*
Transfer - uncertain	-0.0172	0.0647
Transfer – not child	-0.0255	0.0923
Watershed Group	-0.0374	0.0764
Conserv. Prog. - part	0.0425	0.0678
Conserv. Compliance	0.1356	0.0642**
Attitude – erosion1	-0.0366	0.0333
Attitude – erosion3	-0.0626	0.0344*
Attitude – no-till1	-0.2408	0.0325***
Attitude – no-till2	-0.0603	0.0353*
Attitude–social norm	-0.0211	0.0359

*significant at 10% level, ** significant at 5% level and ***significant at 1% level

Table 4. Regression Analysis of Watershed Group Participation, Ohio Farmers, 2004.

Variable	Estimate	Standard Error
Constant	-1.2153	0.6192*
Age < 40	-0.0994	0.2925
Age 40 – 50	-0.6194	0.2246***
Age 50 – 60	-0.3872	0.2061*
Educ. – high school	0.5569	0.3693
Educ. – some college	0.9689	0.3752***
Work Off-Farm	0.2127	0.1830
Total Acres	0.0003	0.0001***
Animal Sales Share	0.5242	0.2626*
High Value Crop Share	0.4026	0.6043
Owned Acres Share	0.1114	0.2717
Conserv. Prog. – part	0.3580	0.1779*
Conserv. Till – 2003	0.3528	0.2250
Attitude – water2	-0.2969	0.1668*
Attitude – water3	-0.0851	0.0939
Attitude–responsible	-0.2178	0.1304*
11_Watersheds	0.2988	0.1690*

significant at 10% level, ** significant at 5% level and ***significant at 1% level

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