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An Analysis of Factors Affecting Participation Behavior of Limited Resource Farmers in Agricultural Cost-Share Programs in Alabama

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This study examines factors that affect the participation behavior of limited resource farmers in agricultural cost-share programs in Alabama. The data were generated from a survey administered to a sample of limited resource farm operators. A binary logit model was employed to analyze the data. Results indicate that college education, age, gross sales, ratio of owned acres to total acres, and rented acres, as well as membership in a conservation association, had significant influence on cost-share program participation.

Key Words: binary logit, cost-share program, limited resource farmers, participation behavior

Current evidence indicates a low participation in government conservation and forest management practices among farmers in general and limited resource or small farmers in particular. Bell et al. (1994) observed a chronically low participation in incentive-based forestry programs and the Conservation Reserve Program (CRP) in Tennessee. A number of other studies (McLean-Meyinsse, Hui, and Joseph, 1994; Dismukes, Harwood, and Bentley, 1997; and Molnar et al., 2000) have all noted lower participation in government-sponsored programs among small and limited resource farmers. This disparity may be partially due to the small average size of qualified acres, lower average crop yields, and higher likelihood of not planting program crops, as well as less sophisticated technology, insufficient collateral, poor cash flow, and poor credit ratings (U.S. General Accounting Office, 1977).

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Conservation and forest management practices are designed to increase reforestation, improve timber stands, increase wildlife habitat, reduce soil erosion, and protect water quality and the environment. Participation in government-sponsored conservation and forest management programs is generally voluntary, with some incentives provided to participants to encourage participation [U.S. Department of Agriculture, Natural Resource Conservation Service (USDA/NRCS), 2000a]. The incentives stem from financial compensation like tax rebates and cost sharing, to nonfinancial assistance such as technical guidance and provision of seedlings (Nagubadi et al., 1996).

Cost-share programs are designed to provide incentives to agricultural producers to implement soil and water conservation practices (Zinn, 1995). Specifically, cost-share programs assist landowners by partially paying for the expenses of installing conservation practices such as site preparation and seeding, tree planting, recreational improvements, and design of resource management plans and erosion control measures. Some examples of cost-share programs are the Emergency Conservation Program, the CRP, the Forest Incentives Program, the Wetland Reserve Program, the Forest Service Stewardship Incentives Program, and the Farmland Protection Program (Zinn, 1995; Nagubadi et al., 1996).

This study focuses on agricultural cost-share programs, with specific emphasis on those programs related to production agriculture. The CRP remains the most popular among these programs in Alabama, with over 10,000 contracts and approximately 484,129 acres enrolled prior to the year 2000, and an additional 967 contracts on 39,713 acres signed in 2000 (USDA/NRCS, 2000b). Initiated in 1985 with the objective of reducing soil erosion on highly erodible cropland, CRP provides cost-share money to establish the required conservation plan and rental payment to farmers. In return, farmers are required to withdraw land from crop production and to plant permanent trees or grass coverage for a full contract period of 10 to15 years.

Several studies have been conducted to examine factors influencing participation in government-sponsored programs. While the results could be generalized for policy purposes in some cases, findings have not been consistent across all states. For example, Bell et al. (1994) found farmers' attitude toward conservation and knowledge of forestry to be more significant indicators of participation than monetary incentives in a study of the Forest Stewardship Incentive Program in Tennessee. In contrast, in their study of soil conservation decisions in Virginia, Norris and Batie (1987) concluded that financial factors and other socioeconomic factors influenced participation.

Clearly, based on results of these earlier investigations, the variables influencing participation in government-sponsored conservation programs may differ depending on the state and the program. Furthermore, while participation in cost-share programs has been examined in several states, no earlier evaluation has considered the case of limited resource farmers (LRFs). This study seeks to fill this void and to further contribute to the existing literature on participation in government-sponsored programs.

The primary objective of this analysis is to evaluate factors influencing participation by limited resource farmers in agricultural cost-share programs in Alabama.

Following Molnar et al. (2000), the term "limited resource farmers" as used in this study refers to farmers with annual gross farm sales of $40,000 or less. A review of the relevant literature is provided in the next section. This is followed by a description of the data, a discussion of the methodology employed, and definitions of the variables. Results of the analysis are then presented. The final two sections offer a summary discussion and concluding remarks.

Review of Literature

This research effort is motivated by a need to understand the distinguishing characteristics of participants in agricultural cost-share programs. Accordingly, this section attempts to identify and summarize key variables used in previous studies to explain participation behavior in government-sponsored programs.

Based on research by Ervin and Ervin (1982), literature on factors affecting adoption practices and use of soil conservation practices began to emerge in 1950. However, there is limited guidance in economic theory for the selection of variables to explain the resource conservation actions of farmers. Prundeaner and Zwerman noted in 1958 that while there may be the same level of hazard between farms, producers differ in implementation of soil conservation schemes due to different socioeconomic environments. Using a random utility model, Bell et al. (1994) examined the likely effect of cost-share incentives on participation in the Tennessee Forest Stewardship Program and identified factors that contribute to participation. Their results indicate attitudes and knowledge of forestry programs may be more influential in a landowner's decision to participate than monetary incentives. Norris and Batie (1987) analyzed farmers' soil conservation decisions using data from a survey of farm operators in two Virginia counties, and concluded that financial factors (income and debt), perception of erosion, educational level, off-farm employment, and tenancy were important influences on the sample farmers' use of conservation practices. Also, they found age, race, and on-farm erosion potential to be significantly related to the use of conservation tillage.

Similarly, in a study of conservation practice choices of CRP farmers in Alabama, Onianwa, Wheelock, and Hendrix (1999) analyzed 594 randomly selected CRP contracts and found education, ratio of cropland in CRP, farm size, gender, prior crop practice, and geographic location of contract to have significant influence on the choice of conservation practice adopted. Nagubadi et al. (1996), in an investigation of program participation behavior of nonindustrial forest landowners in Indiana, observed that total land owned, commercial reasons for ownership, government sources of information, and membership in forestry organizations significantly influence landowners' program participation. Other significant factors reported by Nagubadi et al. include age, fear of loss of property rights, and duration since the first wooded tract was acquired. However, with regard to cost-share programs, the significant factors found to influence participation were location of residence on wooded land and knowledge of and willingness to participate in a conservation easement.

Kalaitzandonakes and Monson (1994) investigated the influence of economic, personal, and attitudinal factors on intended conservation practice of a sample of CRP contract holders in Missouri at the end of their contracts, and found that economic factors such as greater risk aversion and low discount rates had a positive and significant effect on potential conservation effort, while increasing debt load had a negative influence. However, attitudes toward conservation were found to have no significant influence on conservation practice.

Finally, Lynne, Shonkwiler, and Rola (1988) used an extension of the tobit model to examine attitudes and conservation behavior of Florida farmers. Based on their findings, strengthening conservation attitudes would reduce the need for dependence on technical assistance and other net income-enhancing programs. The authors concluded that although economic incentives would increase participation, responsiveness would differ with the strengthening of conservation-related attitudes.

The results reported by the studies cited above provide a basis for the selection of variables to empirically examine the program participation behavior of limited resource farmers in this analysis.

Data Description

The data for this study were generated through a mail survey. The survey was designed to solicit pertinent information to facilitate the study. Information relating to the socioeconomic characteristics of the respondents and their participation in cost-share programs was requested. The mail survey was administered through the National Agricultural Statistics Service (NASS) office in Montgomery, Alabama. The 1997 Census of Agriculture of more than 41,000 Alabama farmers, maintained by NASS and stratified for limited resource farmers, served as the population for the study. These strata consisted of 1,340 minority farm operators and over 24,000 white farm operators reporting cash receipts of $40,000 or less. From this population, 5% (1,215) of the white farm operators were randomly selected, while all the minority operators were included to ensure adequate representation of both groups.

The questionnaire was pre-tested and modified accordingly prior to mailing. A total of 217 minority farm operators and 233 white farm operators completed and returned the surveys from the first round of mailing. To increase the response rate, a follow-up survey was mailed to nonrespondents. This effort resulted in an additional 135 minority responses and 215 white responses, yielding a combined total of 800 respondents. However, 77 surveys were excluded from the analysis due to incomplete information. An additional 13 surveys comprised exclusively of nonagricultural cost-share program participants were also removed. The remaining 710 surveys, consisting of 307 minority farmers and 403 white farmers, were tabulated for the final analysis.

Methodology

Given the dichotomous nature of the data, a logit model as originally suggested by Theil (1972) and redefined by Berkson (1994) was adopted to analyze the data.

Specifically, the logit is defined as the natural logarithmic value of the odds in favor of a positive response (in this case, participation in an agricultural cost-share program). The estimable logit model after transformation is represented as:

$$(1) \qquad L_i = \ln\left(\frac{P_t}{1 - P_t}\right) = Z_i = \beta_0 + \sum \beta_i X_i,$$

where L_i is the logarithm of the odds of participation in cost-share programs (called the logit), X_i represents the independent variables, P_t is the conditional probability of a farmer participating in a cost-share program given X_i, and β_i denotes parameters to be estimated.

Definitions of Variables

Descriptive statistics and definitions of the variables used in the logit model are presented in table 1. The dependent variable (*PARTICIPATE*) is a dichotomous variable of participating or not participating in cost-share programs. A value of 1 was assigned for those respondents who participated in at least one cost-share program, and 0 was assigned for those who had not participated in any. Twenty-nine percent of the respondents (206) participated in at least one agricultural cost-share program.

As reported in table 1, 12 dummy variables were created to facilitate the analysis. The dummy variable *GENDER* was used to distinguish between male (= 1) and female (= 0), and it was hypothesized that males will be less likely to participate in a cost-share program than females. *RACE* was also represented by a dummy variable, with minority = 1 and white = 0. The minority group consists of all non-white respondents in the sample. In this case, minorities were hypothesized to be less likely to participate in agricultural cost-share programs.

Other dummy variables include: *EDUCATION*, with college graduate = 1 and less than college graduate = 0; *PART-TIME_FARM*, with part-time farmers = 1 and other occupations = 0; *CONSERV_MEMBER*, with membership in a conservation organization = 1 and nonmembership = 0; and *OTHER_PROGRAMS*, with participation in other non-cost-share government programs = 1 and nonparticipation = 0. Education, part-time farming, participation in other non-cost-share government programs, and membership in any conservation association were all hypothesized to have a positive effect on participation. Each of the three continuous variables—age (*AGE*), ratio of owned to total acres (*ACRES_RATIO*), and rented acres (*RENTED_ACRES*)—were hypothesized to have positive effects on participation. Gross value of sales (*GROSS_SALES*), used as a proxy for income, was a dummy variable with $5,000 or more = 1 and less than $5,000 = 0.

Finally, six dummy variables were created for the Alabama agricultural reporting districts, following NASS classification, to permit the examination of the regional impacts on cost-share administration (see figure 1). *DIST*1 and *DIST*2 represent the "Tennessee Valley," comprised of substantial real estate development (commercial, industrial, and residential) and premium cropland. Extending across the state,

Table 1. Definitions of Variables Used in the Logit Analysis and Their Descriptive Statistics ($N = 710$ survey respondents)

Variable	Definition	Mean	Std. Dev.	Expected Sign
Dependent Variable:				
PARTICIPATE	1 = participation in at least one cost-share program; 0 = nonparticipation	0.290	0.454	N/A
Independent Variables:				
GENDER	1 = male; 0 = female	0.874	0.331	–
RACE	1 = minority; 0 = white	0.432	0.495	–
EDUCATION	1 = college graduate; 0 = less than college graduate	0.299	0.458	+
AGE	Actual age (years)	59.5	11.58	+
PART-TIME_FARM	1 = part-time farming; 0 = other occupations	0.439	0.496	+
OTHER_PROGRAMS	1 = participation in other non-cost-share government programs; 0 = nonparticipation	0.180	0.385	+
CONSERV_MEMBER	1 = membership in any conservation organization; 0 = nonmembership	0.009	0.283	+
GROSS_SALES	Last year's gross value of sales: 1 ≥ $5,000; 0 = < $5,000	0.369	0.483	+
ACRES_RATIO	Ratio of owned acres to total acres	0.822	0.314	+
RENTED_ACRES	Number of acres rented from others	37.19	238.5	+
	The following six regional dummy variables represent NASS agricultural reporting districts for Alabama.			
*DIST*1	Agricultural District 1	0.170	0.376	?
*DIST*2	Agricultural District 2	0.266	0.442	?
*DIST*3	Agricultural District 3	0.114	0.318	?
*DIST*4	Agricultural District 4	0.184	0.388	?
*DIST*5	Agricultural District 5	0.133	0.340	?
*DIST*6	Agricultural District 6	0.130	0.338	?

*DIST*3 is home to two national forests, Talladega and Bankhead, and is parallel to *DIST*4. *DIST*4 is affectionately termed the "Black Belt," because of the dark soil color characterizing this region. *DIST*5 and *DIST*6, located in the southwestern and southeastern parts of the state, respectively, are home to most of Alabama's privately owned pine forests. However, only five district dummies were included in the model. The *DIST*6 variable was omitted from the estimated equation to avoid singularity.

Results

Two empirical models were estimated. The first estimation was without the district dummy variables, and the second incorporated the district dummy variables. The estimated results of the first model are presented in table 2, including the maximum

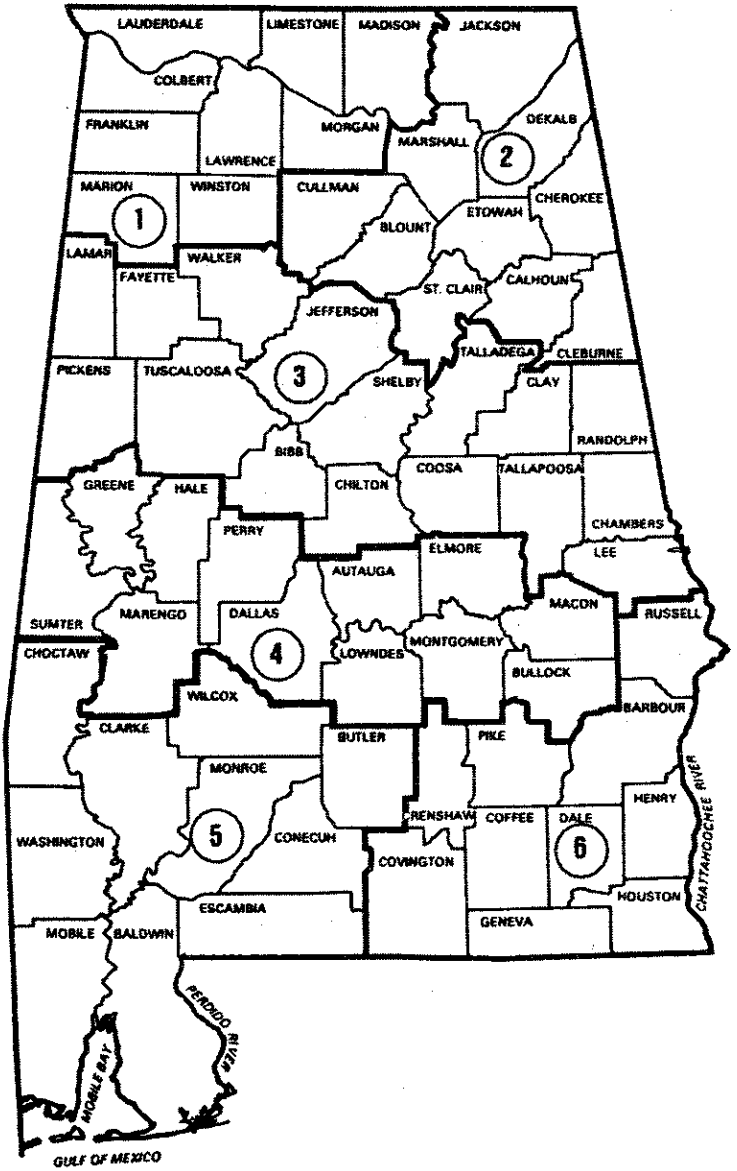

Figure 1. Alabama Agricultural Reporting Districts

likelihood estimated coefficients, Wald test statistics, and the changes in probability, as well as statistical results for the likelihood-ratio test, the Nagelkerke R^2, and the model's prediction success. Measures of goodness of fit indicate the model fits the data fairly well. The likelihood-ratio test, which measures the significance of the logit function, was significant with a score of 50.5, suggesting a relationship exists between the probability of a farmer choosing to participate and the suggested independent variables. Although the R^2 value is low, which is the norm in logistic regression (Hosmer and Lemeshow, 2000), the model correctly predicted 64% (450 out of 710) of the responses using a 30% participation rate. Correct predictions were relatively evenly distributed, with 68% of nonparticipants (340 out of 503) and 53% of participants (110 out of 206) correctly predicted.

Following Bell et al. (1994) and Pindyck and Rubinfeld (1976), the estimated results were interpreted using the change in probability (ΔP_i):

$$\Delta P_i = \beta_j P_i(1 - P_i), \tag{2}$$

where P_i is the estimated probability of participation evaluated at the mean, and β_j is the estimated coefficient of the jth variable. The change in probability (ΔP_i) is a function of the probability, and when multiplied by 100 gives the percentage change in the probability of the event occurring given a change in the variable, all things being equal.

As shown by the results reported in table 2, *EDUCATION* (college graduates), *CONSERV_MEMBER* (membership in a conservation organization), and *GROSS_SALES* (a proxy for income) were positively significant with participation in an agricultural cost-share program at the 1% level, while *AGE*, *ACRES_RATIO* (ratio of owned acres to total acres), and *RENTED_ACRES* were positively significant at the 5% level.

With regard to education, the change in probability (last column in table 2) suggests college graduates were 4.3% more likely to participate in agricultural cost-share programs than farmers with less than college degrees. In the case of age, a unit increase in age (one year) will result in an increase of approximately 0.2% in the probability of participation, while a unit increase in the proportion of owned land (0 to 1) would result in a 7.7% increase in the probability of farmer participation. Simultaneously, the change in probability for rented acres indicates that a unit (one acre) increase in rental acres would result in a 0.012% increase in participation. Similarly, farmers who are members of any conservation organization were about 6.3% more likely to participate in agricultural cost-share programs. The change in probability with regard to gross sales indicates farmers with a gross sales value of $5,000 or above were 2.7% more likely to participate in agricultural cost-share programs.

The coefficients for *GENDER* (male participants), *RACE* (minorities), *PART-TIME_FARM* (part-time farming), and *OTHER_PROGRAMS* (participation in other nonagricultural cost-share programs) were not significant. However, *GENDER* and *PART-TIME_FARM* had the expected signs. Contrary to expectation, *RACE* and

Table 2. Parameter Estimates and Statistical Relationships of Factors Affecting Participation in Agricultural Cost-Share Programs, with Agricultural Reporting Districts Excluded ($N = 710$ survey respondents)

Variable	β Coefficient	Standard Error	Wald Statistic	Change in Probability
Constant	−3.2894	0.6798	23.4124	—
GENDER	−0.3176	0.2537	1.5673	−0.00817
RACE	0.2493	0.1786	1.9481	0.01086
EDUCATION	0.5344**	0.1863	8.2312	0.04315
AGE	0.0178*	0.0079	5.1268	0.00156
PART-TIME_FARM	0.1905	0.1763	1.1674	0.00787
OTHER_PROGRAMS	−0.0451	0.2281	0.0390	−0.00150
CONSERV_MEMBER	0.8521**	0.2837	9.0203	0.06298
GROSS_SALES	0.4994**	0.1834	7.4179	0.02723
ACRES_RATIO	1.0413*	0.4156	6.2791	0.07721
RENTED_ACRES	0.0031*	0.0015	4.1654	0.00012
Log-Likelihood Ratio Test Statistic	= 50.50			
Nagelkerke R^2	= 0.098			
Model Prediction Success	= 63.5%			

Note: Single and double asterisks (*) denote significance at the 5% and 1% levels, respectively.

OTHER_PROGRAMS, although not statistically significant, did not have the hypothesized signs.

Similar to table 2 for the first empirical model, table 3 presents parameter estimates and the same statistical relationships for the model with the agricultural reporting districts included. Again, measures of goodness of fit show the model fits the data fairly well. The likelihood-ratio test was significant with a score of 53, suggesting there was a relationship between the probability of a farmer choosing to participate and the suggested variables. The Nagelkerke R^2 in this case was 0.10, and the model correctly predicted 64.3% (456 out of 710) of the responses. Correct predictions were again relatively evenly distributed, with 68% of nonparticipants (342 out of 503) and 55% of participants (114 out of 206) correctly predicted.

As observed by a comparison of tables 2 and 3, introduction of agricultural districts (table 3) has little or no effect on the results. Again, education (college graduates), membership in a conservation organization, and gross value of sales were positively significant with participation in an agricultural cost-share program at the 1% level, while age, ratio of owned to total acres, and rented acres were all positively significant with participation at the 5% level.

The change in probability with regard to education continues to suggest participants with college degrees were more likely to participate in agricultural cost-share

Table 3. Parameter Estimates and Statistical Relationships of Factors Affecting Participation in Agricultural Cost-Share Programs, with Agricultural Reporting Districts Included ($N = 710$ survey respondents)

Variable	β Coefficient	Standard Error	Wald Statistic	Change in Probability
Constant	-3.4984	0.7306	22.9258	—
GENDER	-0.2995	-0.2558	1.3704	-0.00642
RACE	0.2696	0.1806	2.2277	0.00988
EDUCATION	0.5201**	0.1872	7.7221	0.02396
AGE	0.0195*	0.0080	5.9165	0.00156
PART-TIME_FARM	0.1954	0.1772	1.2166	0.00668
OTHER_PROGRAMS	-0.0562	0.2288	0.0602	-0.00152
CONSERV_MEMBER	0.8709**	0.2851	9.3299	0.05473
GROSS_SALES	0.5116**	0.1841	7.7218	0.02339
ACRES_RATIO	1.0275*	0.4165	6.0851	0.06312
RENTED_ACRES	0.0030*	0.0015	4.0460	0.00010
*DIST*1	0.1130	0.3229	0.1225	0.00358
*DIST*2	0.1359	0.2946	0.2129	0.00440
*DIST*3	0.3843	0.3442	1.2468	0.01565
*DIST*4	-0.1039	0.3212	0.1047	-0.00268
*DIST*5	0.0895	0.3421	0.0685	0.00277
Log-Likelihood Ratio Test Statistic	= 53.0			
Nagelkerke R^2	= 0.10			
Model Prediction Success	= 64.3%			

Note: Single and double asterisks (*) denote significance at the 5% and 1% levels, respectively.

programs (2.4%) than those with less than college degrees. One unit (one year) increase in age will result in an increase of approximately 0.2% in the probability of participation, while a unit (0 to 1) increase in the proportion of owned acres would result in a 6.3% increase in the probability of participating. In the case of rented acres, a unit (one acre) change in rental acres would change the probability of participation by 0.01%.

As before, membership in a conservation organization was positively significant with participation in cost-share programs at the 1% level. Members of a conservation organization were 5.5% more likely to participate in agricultural cost-share programs. Likewise, farmers with gross sales of $5,000 or above were 2.3% more likely to participate in agricultural cost-share programs than those whose sales were less. Again, coefficients for *GENDER*, *RACE*, *PART-TIME_FARM*, and *OTHER_PROGRAMS* were not significant, although *GENDER* and *PART-TIME_FARM* had the expected signs.

Summary Discussion

This research has examined factors affecting limited resource farmers' participation behavior in agricultural cost-share programs. College education, age, ratio of owned to total acres, rented acres, gross value of sales, and membership in a conservation organization were all found to be significant predictors of participation in agricultural cost-share programs.

In the first model (where agricultural reporting districts were excluded), the results showed that participants with college degrees have a 4% higher probability of participating in an agricultural cost-share program than those with less than college degrees. For each unit increase in age or the proportion of owned acres, there was a respective increase of approximately 0.2% and 7.7% in the probability of participation. In the case of rented acres, there was a 0.01% increase in the probability of participation for each unit increase in rental land. The positive and significant outcome for rented acres suggests large farmers may be enrolling less-productive acres in the program while renting more-productive acres for their crop production. Likewise, farmers with gross sales of $5,000 or above were 2.7% more likely to participate in agricultural cost-share programs than those with less than $5,000 in gross sales.

Moreover, membership in a conservation organization was a significant indicator of participation in agricultural cost-share programs. Limited resource farmers who are members in any conservation organization had a higher probability of participating in agricultural cost-share programs. This finding is likely due to the fact that farmers who belong to conservation associations are more environmentally conscious, and therefore much more likely to participate in conservation programs. Similar results were observed by Nagubadi et al. (1996) in their study of program participation behavior of nonindustrial forest landowners in Indiana. The results of our study's second model (with the agricultural reporting districts included) were consistent with those of the first model, suggesting regional differences had no effect on farmers' participation in agricultural cost-share programs.

The combined results of this analysis are generally consistent with findings reported by previous studies. For example, Onianwa, Wheelock, and Hendrix (1999) found education, small farm size, and gender (female), among other factors, to be significant indicators of long-term conservation choice commitment among CRP participants in Alabama. Likewise, in the present study, education, owned acreage, age, gross sales, and rented acreage, as well as membership in a conservation organization, were among the significant indicators of participation in an agricultural cost-share program. Although gender was not statistically significant, the negative sign was consistent with the Onianwa, Wheelock, and Hendrix earlier study. However, while their study found geographic location of contracts had a significant influence on the practice choice of CRP farmers, our results show this factor had no influence on the participation of LRFs in an agricultural cost-share program. Moreover, while age was a significant predictor of participation in cost-share programs, it was not significant with regard to the conservation practice choice of CRP farmers in Alabama.

The gender variable may have overshadowed the age variable in the CRP study. Consistently, Norris and Batie (1987) found education and age (among other factors) to be important in the use of conservation practices in Virginia, while Nagubadi et al. (1996) observed that owned land, membership in a forestry organization, and age affected participation behavior of nonindustrial forest landowners in Indiana.

Conclusion

From a policy perspective, the results of this study provide further insights into the characteristics of participants in agricultural cost-share programs. This information would assist in the design of policies to enhance agricultural cost-share programs in particular and other government-sponsored programs in general.

Zabawa (1989); Madden and Tischbein (1979); and DeWalt (1985) have all noted the importance of directing agricultural policy to specific clientele to be effective. Consequently, to enhance participation in agricultural cost-share programs, different strategies could be designed to target specific groups of farmers based on their educational background, age, proportion of owned land in the total operation, as well as whether or not farmers are affiliated with conservation organizations.

Regardless of race, agricultural cost-share program participation was greater among conservation awareness organization members than among nonmembers. Hence, a more inclusive membership campaign by formal conservation organizations likely would significantly boost agricultural cost-share program participation. This may be particularly true of minority farmers who are perhaps out of the loop with regard to informal conservation groups. Therefore, government agencies may find collaborations with nongovernmental conservation organizations an effective means through which farmer stewardship of land and water resources could be encouraged while simultaneously reducing environmental costs to the larger community.

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