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Factors Affecting Conservation Practice Behavior of CRP Participants in Alabama

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This study examines the factors that affect conservation practice choices of CRP farmers in Alabama. From over 9,000 contracts enrolled in the state between 1986 and 1995, 594 were randomly selected for the study. A multiple-regression analysis was employed to analyze the data. Results indicate that education, ratio of cropland in CRP, farm size, gender, prior crop practice, and geographic location of contract had a significant influence on the choice of conservation practice adopted.

Key Words: conservation practices, Conservation Reserve Program, CRP contracts, cost share, erodible cropland, grass practice, land retirement, tree practice

Previous land retirement programs were designed to compensate farmers for taking cropland out of production in order to reduce excess food production. For example, the Soil Bank program was established in 1956 to turn cropland from production to a conserving use, while the Payment-In-Kind (PIK) program was established in 1983 to set aside 50% of cropland base. However, the voluntary nature and economic conditions surrounding these programs forced much of the land back into production. Nevertheless, the experience gained through such precursor land programs was helpful in shaping the current Conservation Reserve Program (CRP).

CRP was designed to accomplish the dual objectives of controlling soil erosion and reducing overproduction capacity (Knutson, Penn, and Boehm). Introduced as a component of the 1985 farm bill, the CRP targeted to remove from production highly erodible croplands and, at the same time, to reduce excessive soil loss for at least a 10-year period. Under CRP, landowners may retire cropland to trees, permanent wildlife habitat, permanent introduced grasses and legumes, permanent native grasses and legumes, or combinations of permanent covers (Hamilton, Gardner, and

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Hazel). The vegetative cover established on the retired land improves surface water quality, creates wildlife habitat, preserves soil productivity, protects ground water, and reduces off-site wind erosion damage.

Between 1987 and 1990, yearly average erosion reduction on CRP acres was 19 tons per acre (Heimlich and Osborn). In Alabama, the CRP successfully reduced soil loss on the enrolled acres from 10,696,039 tons to 686,980 tons per year, and of the more than 500,000 acres enrolled in CRP in the state during this period, approximately 98% were covered in trees or grasses (Onianwa and Wheelock).

The objective of this study was to evaluate factors that influenced the conservation practice choice of CRP farmers in Alabama. The benefit of a cost-share program such as the CRP can be measured by the long-term retention of established practices on the enrolled acres.

Earlier investigations have shown that tree planting has a higher retention rate than other conservation practices. For example, Onianwa et al. (1997, 1999) reported a higher intended retention rate for CRP tree acres in Alabama as opposed to other conservation practices. Under CRP, a variety of conservation practices were established. These include trees, grasses, field windbreaks and shelterbelts, erosion-control structures, shallow water for wildlife, grassed waterways, and permanent wildlife habitat. An understanding of the factors that motivated the choice of a particular conservation practice is crucial in designing strategies to encourage the practice choice that best assures long-term benefits and sustainability.

In the next section, we provide a review of the relevant literature on conservation practice behavior. This is followed by a discussion of the methodology employed in our analysis and a description of the data used. The results of the multiple-regression analysis are then presented. The article ends with a summary of our conclusions and brief comments addressing the policy implications of this research.

Review of Literature

A review of previous studies revealed that factors affecting farmers' conservation behavior have been extensively addressed. Indeed, literature on factors affecting adoption practices and use of soil conservation practices began to emerge in 1950 (Ervin and Ervin). However, economic theory provides limited guidance in the selection of variables to explain the resource conservation actions of farmers. Prundeaner and Zwerman, in 1958, noted 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. Blase, in a 1960 study of Iowa farmers, showed that off-farm income, perception of soil erosion problem, and capital were significant in explaining reductions in soil loss. In their 1979 analysis, Earle, Rose, and Brownlea identified education, farm size, gross income, double-cropping as a measure of efficiency, and net farm income as key factors affecting soil conservation practices among Palouse farmers in Australia.

Based on findings of their 1977 study of Illinois farmers, Pampel and van Es reported that a variable representing experience in farming was significant in explaining adoption of environmental practices, while the size of farm best explained adoption of commercial practices. Similarly, in a study of Nebraska farmers in 1980, Hoover and Wiitala observed that age is an important predictor of soil conservation practice. The authors reported that young and more educated farmers were found to perceive erosion as a problem.

Ervin and Ervin included attitudinal and institutional variables in a 1982 theoretically sound model of conservation decisions, although their empirical results did not show these variables to be significant among Missouri farmers (Lynne, Shonkwiler, and Rola). Younger farmers appear to be more receptive to a wider range of practices due to higher education, heightened erosion perception, and lower risk aversions. Further, in their 1979 investigation, Novak and Korsching found risk attitudes, cost-sharing, institutional contacts, erosion potential, and farm size to be significant factors affecting adoption of conservation practices. Finally, Norris and Batie included variables of age, education, race, farm size, and tenure in a 1987 study of Virginia farmers.

The set of variables selected for our examination of factors affecting the conservation adoption practices of Alabama farmers under the CRP was based on our review of the studies identified above.

Method of Analysis

A multivariate analysis employing the multiple-regression technique was used to examine the relationship between the conservation choices of Alabama CRP farmers and the selected explanatory variables. Specifically, two models were used to analyze the effects of the selected variables on the conservation choices of Alabama CRP farmers. The models are expressed in general form as:

$$CP_i = f(X_i + \ldots + X_n),$$

where CP_i denotes the conservation practice choice (i.e., the proportion of trees or grass in contract), and the X terms ($X_i, \ldots, X_n$) represent the explanatory variables (see table 1 for a listing of variables and their definitions).

Data Description

The data for this study were taken from a survey of Alabama CRP participants conducted in 1996 (Onianwa et al., 1997). The survey was designed to collect pertinent information about the post-contract intentions of CRP participants in the state. In addition, the survey solicited information on socioeconomic variables relating to the participants. From a total of over 9,000 CRP contracts established between 1986 and 1995 in Alabama, 50% of the minority contracts along with approximately 5% of the white contracts were randomly selected for our analysis. This resulted in a

Table 1. Descriptive Statistics and Definitions of Variables Used in the Analysis of Alabama CRP Farmers' Conservation Practice Choice

Variables	Definition of Variable	Classification	Mean	Standard Deviation
Dependent Variables:				
PROPTREE	Proportion of tree acres in contract	percent	0.687	0.457
PROPGRAS	Proportion of grass acres in contract	percent	0.295	0.451
Independent Variables:				
*AGE*1	25 to 40 years old	dummy	0.030	0.172
*AGE*2	41 to 65 years old	dummy	0.551	0.499
*AGE*3	Over 65 years old	dummy	0.419	0.495
CONACRE	Acres in the CRP contract	continuous	41.331	61.347
CORN	Cropland in corn before CRP	dummy	0.416	0.494
COTTON	Cropland in cotton before CRP	dummy	0.139	0.346
DUMMYPS	Dummy variable for the percent slope of contract acres > 3%	dummy	0.906	0.293
GENDER	Male farmer	dummy	0.650	0.478
HSGRAD	High school education and above	dummy	0.821	0.385
LATITUDE	Degrees North (county centroids)	continuous	32.790	1.334
LONGITUDE	Degrees East (county centroids)	continuous	−86.908	0.835
FULLTIME	Full-time farmer	dummy	0.067	0.250
PARTTIME	Part-time farmer	dummy	0.482	0.501
RETIRED	Retired farmer	dummy	0.451	0.499
%YTIMBER	Percent of participant's farm income coming from timber	continuous	6.686	22.267
RACE	White farmer	dummy	0.862	0.346
RACLCRP	Ratio of total CRP acres to total farmland acres	continuous	0.308	0.248
SOYBEANS	Cropland in soybeans before CRP	dummy	0.416	0.494
SLLENGTH	Slope length of contract acres in feet	continuous	173.209	75.362
TOTFARM	Sum of cropland and farmland acres	continuous	509.650	1,064.788
*DIST*1	Alabama Agricultural Reporting District	dummy	0.177	0.382
*DIST*2	Alabama Agricultural Reporting District	dummy	0.103	0.305
*DIST*3	Alabama Agricultural Reporting District	dummy	0.157	0.365
*DIST*4	Alabama Agricultural Reporting District	dummy	0.128	0.334
*DIST*5	Alabama Agricultural Reporting District	dummy	0.221	0.416
*DIST*6	Alabama Agricultural Reporting District	dummy	0.216	0.412

total of 94 minority contract holders and 500 white contract holders from the state. Thus a combined total of 594 contract holders were surveyed for the study. To mitigate the problem of multiple-contract holders, contracts rather than participants were the basis for sample selection. Of the 594 surveys administered, a total of 214 survey instruments (36%) were completed and returned. Ten of the 214 returned surveys had missing information or could not be matched with any record in the sample, resulting in a final total of 204 usable surveys for our study sample.

The data set used for the analysis was constructed from these survey data. Because a preliminary analysis of the data indicated that about 98% of the acres in CRP in the state were planted in either trees or grass, the choices examined were limited to these two practices. Consequently, the study's two dependent variables were the CRP tree acres and the CRP grass acres—measured as the proportion of CRP tree acres to total acres in the contract (*PROPTREE*) and the proportion of CRP grass acres to total acres in the contract (*PROPGRAS*), respectively. (A summary of the descriptive statistics of the data used in the analysis is presented in table 1.)

The six Alabama Agricultural Reporting Districts (*DIST*1, …, *DIST*6) were included in the analysis to allow an examination of the regional impacts on CRP 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, *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.

Results of Regression Analysis

The multiple-regression analysis results for CRP tree acres without inclusion of the geographic locations are presented in table 2. The findings show that eight variables were significant at either the 5% or the 1% level. As seen in table 2, for a 1% increase in the proportion of cropland in CRP (*RACLCRP*), there was a 0.61% decrease in tree planting. Similarly, for each 1% increase in total farmland (*TOTFARM*), there was a 0.00007% decrease in tree cover. Male farmers (*GENDER*) were less likely to plant trees on CRP acres. On average, male participants placed 0.12% less CRP land in trees than their female counterparts, suggesting that males are more likely to convert conservation acres to crop production. For each 1% increase in prior cotton acres enrolled in CRP (*COTTON*), participants diverted 0.24% less CRP acres to tree planting. Education was a significant indicator of tree planting on CRP acres. Farmers who attained at least high school education (*HSGRAD*) enrolled, on average, 0.18% more CRP land in trees regardless of their status on other variables. Also, for each 1% increase in income from timber (*%YTIMBER*), there was a 0.003% increase in tree planting on CRP acres. Each one degree increase in latitude North (*LATITUDE*) resulted in a

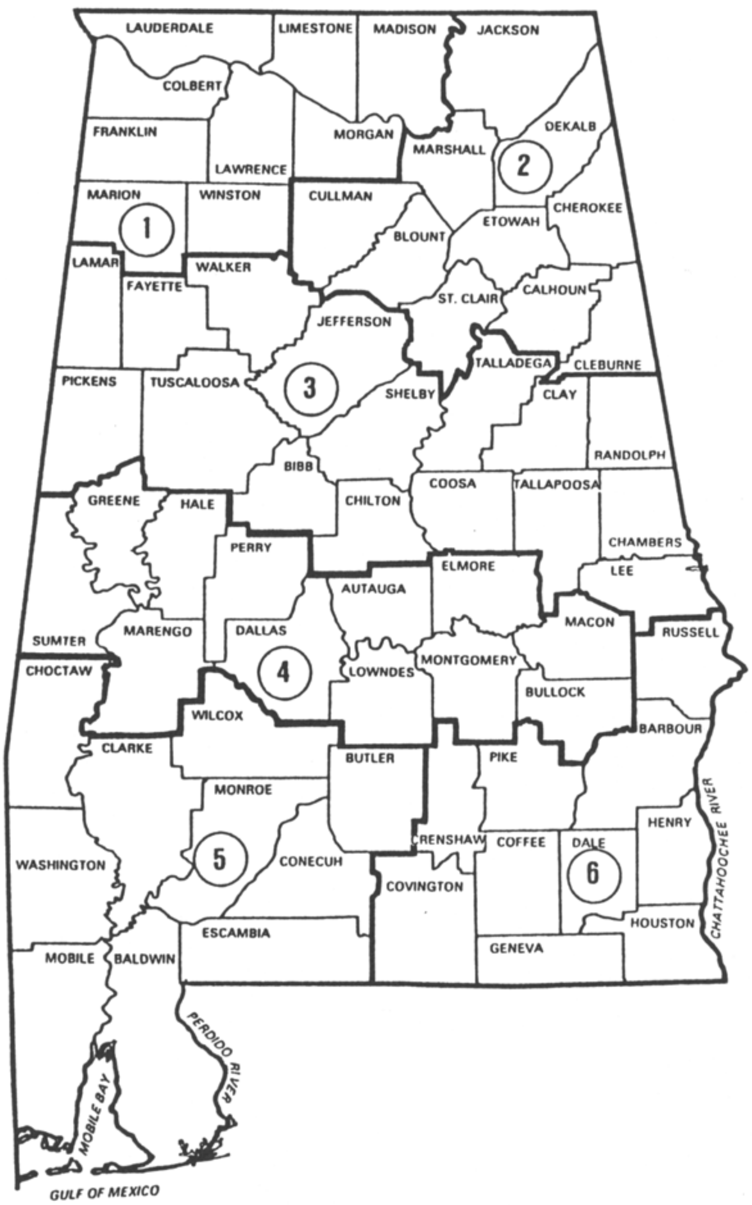

Figure 1. Alabama Agricultural Reporting Districts

Table 2. Results of Regression Analysis for Tree Cover Without Geographic Locations

Variable	Coefficient	Standard Error	*t*-Value
Latitude degrees North (*LATITUDE*)	−0.184	0.019	−9.664**
Longitude degrees East (*LONGITUDE*)	−0.072	0.030	−2.372*
Cotton before CRP (*COTTON*)	−0.243	0.074	−3.270**
High school education and above (*HSGRAD*)	0.180	0.063	2.863**
% Farm income from timber (*%YTIMBER*)	0.003	0.001	2.419*
Ratio of cropland in CRP (*RACLCRP*)	−0.612	0.107	−5.740**
Male farmer (*GENDER*)	−0.124	0.052	−2.392*
Total farmland (*TOTFARM*)	−0.00007	0.00003	−2.418*
Constant	0.627	2.581	0.243
F-Statistic = 24.203, Model R^2 = 0.509			

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

Table 3. Results of Regression Analysis for Tree Cover with Geographic Locations

Variable	Coefficient	Standard Error	*t*-Value
Latitude degrees North (*LATITUDE*)	−0.202	0.018	−11.296**
Longitude degrees East (*LONGITUDE*)	−0.033	0.029	−1.135
Cotton before CRP (*COTTON*)	−0.212	0.069	−3.080**
High school education and above (*HSGRAD*)	0.126	0.059	2.146*
% Farm income from timber (*%YTIMBER*)	0.002	0.001	2.168*
Ratio of cropland in CRP (*RACLCRP*)	−0.453	0.102	−4.422**
Male farmer (*GENDER*)	−0.112	0.048	−2.339*
Total farmland (*TOTFARM*)	−0.00004	0.00003	−1.484
District 3 (*DIST*3)	0.393	0.071	5.554**
Constant	4.555	2.484	1.834
F-Statistic = 28.696, Model R^2 = 0.582			

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

0.18% decrease in tree planting. Similarly, for each one degree increase in longitude East (*LONGITUDE*), there was a 0.07% decrease in tree planting. The R^2 for the model was 0.51, suggesting that 51% of the variation in tree planting was explained by the variables.

In table 3, the relationships between tree practice and the explanatory variables controlling for the geographic locations (Alabama Agricultural Reporting Districts) are examined. Results indicate that seven variables were significant at the 5% level or less. Farmers in District 3 (*DIST*3) placed 0.39% more CRP acres in trees, on average. Again, the higher the proportion of cropland in CRP (*RACLCRP*), the less CRP acres were converted to trees—i.e., for each 1% increase in cropland, there was a 0.45% decrease in tree planting. Consistently, male farmers (*GENDER*), prior cotton acres (*COTTON*), and total farmland (*TOTFARM*) were all negatively associated with tree planting. Again, there was a positive and strong significant relationship between high school education (*HSGRAD*) and the adoption of tree planting, and between percentage of farm income from timber (*%YTIMBER*) and tree planting. The *LATITUDE* variable was negative and significant at the 1% level, while *LONGITUDE* was still negative but nonsignificant. Notably, the *LONGITUDE* variable was significant at the 5% level (table 2) until the agricultural reporting districts were entered into the regression, suggesting that the regional influence (District 3 and the two national forests) on tree planting in CRP acres was the stronger determinant in the farmer's conservation choice. The only regression coefficient to increase was latitude degrees North (*LATITUDE*), from –0.18 to –0.20. Once the equation had been controlled for unique forested-related characteristics of District 3, farmers in the Northern latitude were less likely to plant trees. The degree of significance of the *LONGITUDE* variable lessened as the districts were introduced, suggesting that many of the tree contracts were in the western part of District 3. Also, total acres of farmland (*TOTFARM*) became less significant, indicating that District 3 farmers were larger farmers on average. Based on a model R^2 of 0.58, 58% of the variation in tree planting was explained by the model. The incremental variance explained by the *DIST*3 dummy variable was significant.

Table 4 presents results of the regression analysis for grass acres without the geographic locations. Seven variables were significant at the 5% level or less, while only one variable was not significant. For a 1% increase in the ratio of cropland in CRP (*RACLCRP*), there was a 0.65% increase in grass acres. Also, both prior use of acres for cotton production (*COTTON*) and male participants (*GENDER*) had a positive relationship with CRP grass acres: each 1% increase in prior cotton acres produced a 0.26% increase in grass cover, and for each 1% increase in male farmers, participants placed 0.16% more CRP acres in grass cover. This latter finding suggests that males were more likely to return acres to crop production at the end of the contract. In contrast, the higher the percentage of farm income from timber (*%YTIMBER*), the lower the percentage of CRP acres placed on grass cover—i.e., for each 1% increase in the income from timber, 0.003% less CRP acres were planted to grass. Part-time farmers (*PARTTIME*) were less likely to plant grass on CRP acres. As reported in table 4, for each 1% increase in part-time farmers, participants

Table 4. Results of Regression Analysis for Grass Cover Without Geographic Locations

Variable	Coefficient	Standard Error	*t*-Value
Latitude degrees North (*LATITUDE*)	0.165	0.019	8.681**
Longitude degrees East (*LONGITUDE*)	0.054	0.031	1.735
Part-time farmer (*PARTTIME*)	−0.112	0.050	−2.223*
Cotton before CRP (*COTTON*)	0.260	0.074	3.507**
% Farm income from timber (*%YTIMBER*)	−0.003	0.001	−2.497*
Ratio of cropland in CRP (*RACLCRP*)	0.650	0.106	6.112**
Male farmer (*GENDER*)	0.163	0.052	3.132**
Total farmland (*TOTFARM*)	0.00007	0.00003	2.411*
Constant	−0.765	2.633	−0.290
F-Statistic = 22.967, Model R^2 = 0.495			

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

Table 5. Results of Regression Analysis for Grass Cover with Geographic Locations

Variable	Coefficient	Standard Error	*t*-Value
Latitude degrees North (*LATITUDE*)	0.183	0.018	10.090**
Longitude degrees East (*LONGITUDE*)	0.017	0.030	0.562
Part-time farmer (*PARTTIME*)	−0.098	0.047	−2.082*
Cotton before CRP (*COTTON*)	0.235	0.070	3.387**
% Farm income from timber (*%YTIMBER*)	−0.002	0.001	−2.241*
Ratio of cropland in CRP (*RACLCRP*)	0.509	0.103	4.938**
Male farmer (*GENDER*)	0.151	0.049	3.090**
Total farmland (*TOTFARM*)	0.00005	0.00003	1.644
District 3 (*DIST*3)	−0.363	0.071	−5.124**
Constant	−4.437	2.560	−1.733
F-Statistic = 26.348, Model R^2 = 0.56			

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

converted 0.11% less CRP acres to grass cover. This suggests that part-time farmers are less likely to return acres to crop production. Both the *LATITUDE* and *LONGITUDE* variables were positively related to grass cover; i.e., for each 1% increase in latitude degrees North and longitude degrees East, there was a 0.17% and 0.05% increase, respectively, of establishing grass cover. With a value of 0.495, the model R^2 indicates that about 50% of the variation was explained by the model. As with the tree cover analysis, after controlling for the North-South difference in the agricultural economy, individual farm characteristics were still predictive of conservation practice. It was found that larger cotton farms with higher proportions of CRP-qualified land, operated by retired or full-time male farmers, placed more CRP acres in grass conservation practice.

In table 5, the model controlled for geographic locations of CRP acres in examining the relationships between grass practices and the explanatory variables. Seven variables were significant at the 5% level or less, while two variables were not significant. Farmers in District 3 placed less acreage in grass cover; for each 1% increase in *DIST*3, participants placed 0.36% less acres in grass cover. The higher the ratio of cropland in CRP (*RACLCRP*), the more likely the acres would be devoted to grass cover—i.e., for each 1% increase in cropland in CRP, farmers placed 0.51% more acres in grass cover. Prior cotton production on CRP acres (*COTTON*) was also positively related to grass practice, suggesting that farmers who previously produced cotton on CRP acres placed more acres in grass cover. Likewise, male farmers (*GENDER*) converted 0.15% more CRP acres to grass cover, but farmers with a high percentage of farm income from timber (*%YTIMBER*) placed less CRP acres on grass cover. Again, part-time farmers (*PARTTIME*) were less likely to plant grass on CRP lands. Each 1% increase in latitude degrees North or longitude degrees East produced a corresponding 0.18% and 0.02% increase in grass cover, respectively, although the *LONGITUDE* variable was not significant. The model R^2 of 0.56 indicates that 56% of the variation was explained by the model. While the introduction of the geographic dummy variable (*DIST*3) decreased the coefficients for all other variables except latitude degrees North, it added significant incremental variance to the model. The negative relationship of District 3 with grass practice suggests that latitude degrees North and farm characteristics were strong indicators of grass practices on CRP acres. The influence of the national forest may be the reason for the strong coefficient reported for latitude degrees North.

Summary and Conclusions

This study evaluated factors that influenced the conservation practice choice of Alabama CRP farmers, using data collected from a 1996 survey of CRP contract holders. Because tree and grass covers were the prevalent practice choices of Alabama CRP farmers, our analysis focused on these two conservation practices. Results indicate that high school education and the percentage of farm income from timber production were strong predictors of tree plantings. When the geographic locations were introduced, participants in District 3 areas bordering national forests established more tree covers on CRP acres. Conversely, prior cotton production on CRP acres, the ratio of total CRP acres to total farmland acres, male participants, and farm size were all negative predictors of tree planting on CRP acres. Further, both latitude degrees North (cotton and grain regions) and longitude degrees East (peanut regions) had a negative and significant relationship with tree planting.

Results of the analysis for grass practice show the variables of prior cotton production, ratio of total CRP acres to total farmland acres, male farmers, and farm size (total farmland) were all positive and significant. With specific regard to gender, male participants were more inclined to establish grass practices than were female participants. Conversely, part-time farmers were less likely to establish grass or tree covers on CRP acres, suggesting that the smaller part-time farmers may have favored wildlife habitat rather than grass or tree planting. The higher the percentage of farm income from timber production, the lower the percentage of grass practice established. The results remained consistent when the geographic locations were introduced, except that there was less adoption of grass practices by farmers in District 3. This may be due to the national forests located in that geographic region.

The findings of this analysis are consistent with those of previous conservation practice studies. Education, prior land use, gender, farm size, and farmer status (full-time, part-time, or retired) were all found to significantly affect the conservation behavior of Alabama CRP farmers. In addition, traditional regional cropping patterns had a strong influence on the choice of conservation practice adopted.

From a policy perspective, the results of this study provide information on participants' general characteristics that would aid in the design of an effective and efficient conservation program in the future. Policies could be formulated to target certain participants based on gender, education, or other identified characteristics to enhance the success of future conservation programs.

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