

# A CERTAINTY PROGRAM FRAMEWORK FOR MARKET-BASED CONSERVATION OF LONGLEAF PINE CONSERVATION

Damien Singh, Fred Cabbage, Nils Peterson, Michelle Lovejoy, Jessica Pope, Suzanne Jervis, Chris Serenari, Amanda Dube, and Brian Hays<sup>1</sup>

**Abstract**—This research analyzed the potential supply of longleaf pine habitat in southeast North Carolina for an ecosystem-based credit market using landowner surveys. Results from a logistic regression analysis and a choice-based conjoint (CBC) statistical analysis revealed that landowners were most influenced by program requirements such as contract length and legal obligation in a conservation contact. Short-term contract agreements of 5 to 10 years were favored, as were minimal land restrictions. Annual payments were somewhat less important than contract agreement or level of obligation, although higher payments were more desirable, as expected. The initial cost-share rate and level of technical assistance were the least important factors affecting willingness to participate in longleaf conservation programs. The presence of longleaf pine on the landowner’s property, previous participation in a Farm Service Agency benefits program, a willingness to participate in a permanent easement to promote longleaf pine, the amount required to accept a permanent easement, and ownership of 101–500 acres of forest positively impacted landowners’ interest in a conservation credit program to promote longleaf pine habitat. Conversely, persons who were unwilling to participate in a permanent easement were less interested.

## INTRODUCTION

We performed a U.S. Department of Agriculture (USDA) Conservation Innovation Grant (CIG) project entitled, “Market Based Conservation Initiative for Longleaf Pine Habitat Improvements in Eastern North Carolina.” This paper summarizes research based on surveys of landowners in the key counties to assess their willingness to plant longleaf pine, work with nontraditional partners seeking habitat credits, interact with farm and forestry support agencies, gauge their knowledge of Endangered Species Act issues, and determine cost-share payment rates that might be required to foster credit creation. A map of the counties is shown in the methods section. We used one large survey and two statistical methods—a choice-based conjoint (CBC) analysis and a regression analysis, described below—to examine the interest of landowners in participating in various conservation programs to create, enhance, or restore longleaf pine ecosystems.

Conservation markets need a supply of a product or service—landowners who will supply the service—and demand from some entity to buy the conservation good or service. In the case of conservation credit markets, private landowners may enter into temporary contracts or

permanent easements directly with buyers or with brokers to create and ultimately supply credits to individuals, businesses, or Government entities seeking an investment opportunity, positive public relations coverage, and/or to offset damages to the environment. Such agreements can vary in their provisions; however, they generally place stringent land management and legal requirements on the participant in return for financial compensation, regulatory assurances, and program assistance.

Private lands are crucial for ecosystem services and habitat conservation. In the United States, 914.5 million acres of land were classified as farmland (40 percent of the total area), and there were 2.1 million farms (USDA NASS 2014). In the lower 48 States, about 70 percent of the *total* land area is in private ownership, and about half of all the land is managed as cropland, pastureland, and rangeland by private landowners (Heard and others 2000, cited in Gray and Teels 2006). Approximately 65 percent of *all* land in the United States is owned privately.

For the 766 million acres of *forest* land in all States, the public sector owns a greater share at 321 million ha (42 percent). There are 445 million acres of private forest land, or 58 percent, with about 10 million forest

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<sup>1</sup>Damien Singh, Research Assistant, North Carolina State University; Fred Cabbage Professor, North Carolina State University; Nils Peterson, Associate Professor, North Carolina State University; Michelle Lovejoy, Executive Director, North Carolina Foundation for Soil and Water Conservation; Jessica Pope, Research Assistant, North Carolina State University; Suzanne Jervis, Ph.D. student, North Carolina State University; Chris Serenari, Human Dimensions Specialist, North Carolina Wildlife Commission; Amanda Dube, GIS Specialist, Texas A&M University; and Brian Hays Associate Director, Texas A&M University.

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landowners. Private noncorporate owners hold 39 percent (298 million acres) of the Nation's forest land, and private corporate owners hold 19 percent (147 million acres). In the 13 Southern States from Texas to Virginia, private noncorporate and family forest owners hold 60 percent of the forest land, and private corporate owners hold 27 percent (Oswalt and others 2014).

Public assistance for natural resource conservation by individuals on private lands is an objective of Government and nongovernment organizations, ranging from international, to local scales. There are literally thousands of financial and technical assistance programs and cooperative programs that provide economic incentives for sustainable use, conservation, and protection of natural resources, including land, water, fish and wildlife, forests, rangelands, and croplands.

Various conservation programs provide payments to encourage private landowners to perform conservation practices on their land. The structure of the payments required, contract or easement terms, and technical assistance required influence the enrollment in and success of the programs (e.g., Rodriguez and others 2012, Sorice and others 2011, 2013). Longleaf pine has become an important conservation priority in the South in the last decade or so, and we examined the economics and program characteristics that would encourage private landowners to plant or restore more longleaf. Approximately 4.7 million acres of longleaf pine (LLP) exist in the southeast region, of which 61 percent are on private lands (ALRI 2014). Given these conditions, successfully promoting LLP habitat through the implementation of a credit market hinges on its widespread adoption by private, nonindustrial landowners. LLP is most noted for its ability to provide habitat for the endangered red-cockaded woodpecker (RCW), but it has many other broad biodiversity and ecosystem functions and values that would make it attractive as a credit market opportunity.

This paper is divided into two parts. First, we review current literature on landowner interest in conservation in Southeastern United States. Second, we analyze a survey conducted of landowners in 38 eastern North Carolina counties to examine how they prioritize provisions of a theoretical performance contract and the variables associated with interest in LLP conservation.

## BRIEF LITERATURE REVIEW

Considerable research has examined landowners' views and interest in conservation in the Southeast United States in North Carolina. Rodriguez and others (2012) found landowners prefer contracts to permanent easements, and while many were interested in protecting endangered

species, it was the lowest priority among conservation issues. They also found interest in conservation was negatively correlated with age and positively correlated with past participation in conservation programs, positive perceptions of endangered species protection, and lower property requirement scores. Golden and others (2012) studied North Carolina landowners and found that they are more likely to be interested in wildlife conservation if they resided on their property, hunt and/or have a family member that hunts, and were younger and male.

Although the terms of conservation performance contracts may vary, they usually contain several common attributes including, but not limited to: length; legal obligation to maintain land during and after contract; financial assistance to help with establishment costs; incentive payments to compensate for potential loss in income; and level of program assistance received prior to and during the contract period. Some research has used novel approaches to shed light on how landowners prioritize such conditions. For instance, Sorice and others (2013) studied family-forest landowners in the Southeast United States, using a choice model to determine preferences for participation in a program to protect the gopher tortoise. They found a strong aversion to strict regulatory programs, or ones that require permanent easements or put landowners at risk of future regulation.

In general, conservation programs may provide contracts, which are temporary legal agreements between the program's managing agency and a landowner, and easements, which are permanent changes in the rights to use the land. Conservation contracts usually provide a specific cost-share payment for establishing a conservation practice, and usually have annual payments for maintaining those practices. The cost-share payment covers a portion of the costs that landowners incur when performing a practice, ranging from 50 percent to 100 percent depending on the needs, the practice, the State, and the type of landowner. The annual payments may occur for a decade or more for conservation contracts, where the landowner agrees to keep a practice in place for the duration of the contract. Landowners also may enter into a long-term or permanent easement, which is a specific legal instrument that mandates they perform a practice or restricts their land use rights and is registered on the title to their land. This may include some establishment costs and then a fixed payment for the easement rights, usually as a lump-sum, up-front payment (Cubbage and others 2017).

Easement agreements are more expensive than conservation contracts, and they are less common but still prevalent. Most landowners are apt to prefer short-term easements with payments for a fixed term so they can break a contract if need be, or simply wait until it

expires before changing the conservation practice or land use. However, landowners who truly want to protect and conserve their land use in perpetuity, and receive a greater payment for themselves, not their heirs, may prefer to sell their land with a permanent conservation easement, or just sell the conservation easement and retain the land (Cubbage and others 2017).

## LANDOWNER INTEREST IN LONGLEAF CONSERVATION PROGRAMS

### Landowner Survey Methods

We conducted a survey of landowners in 38 counties in eastern North Carolina that fell within the historical longleaf pine range as identified by the Longleaf Alliance strategic plan (fig. 1).

Working with various forest and agriculture associations and cooperative extension agents, we developed a sample frame composed of (1) individuals for whom the research team secured personal email addresses (e.g., North Carolina Forest Development Plan longleaf incentive program participants), and (2) organizations who would rather not share internal information but agreed to send our emails with links to the survey directly to

landowners on our behalf (e.g., The Farm Bureau). Drafts of the survey were developed, reviewed by the project personnel, presented for discussion at CIG stakeholder meetings, and revised for the final survey instrument. The surveys were reviewed by the North Carolina State University Institutional Review Board, modified, and approved before sending them out.

Data were collected from respondents through a pre-tested questionnaire constructed and administered on an online server hosted and maintained by North Carolina State University. Approximately 1,000 survey requests we sent electronically and another 2,000 via regular postal service mail. These requests asked landowners to go to the Web site to complete the survey because part of the survey specifically required interactive Web replies. Our sample included 374 landowners (only 243 completed the entire survey) who owned forest, agriculture land, or a combination thereof with acres ranging from less than 50 acres to more than 5,000 acres.

The survey consisted of two parts. First, it asked 1 open-ended question (age) and 25 multiple-choice questions related to respondents' demographics, land characteristics, interest in conservation programs and

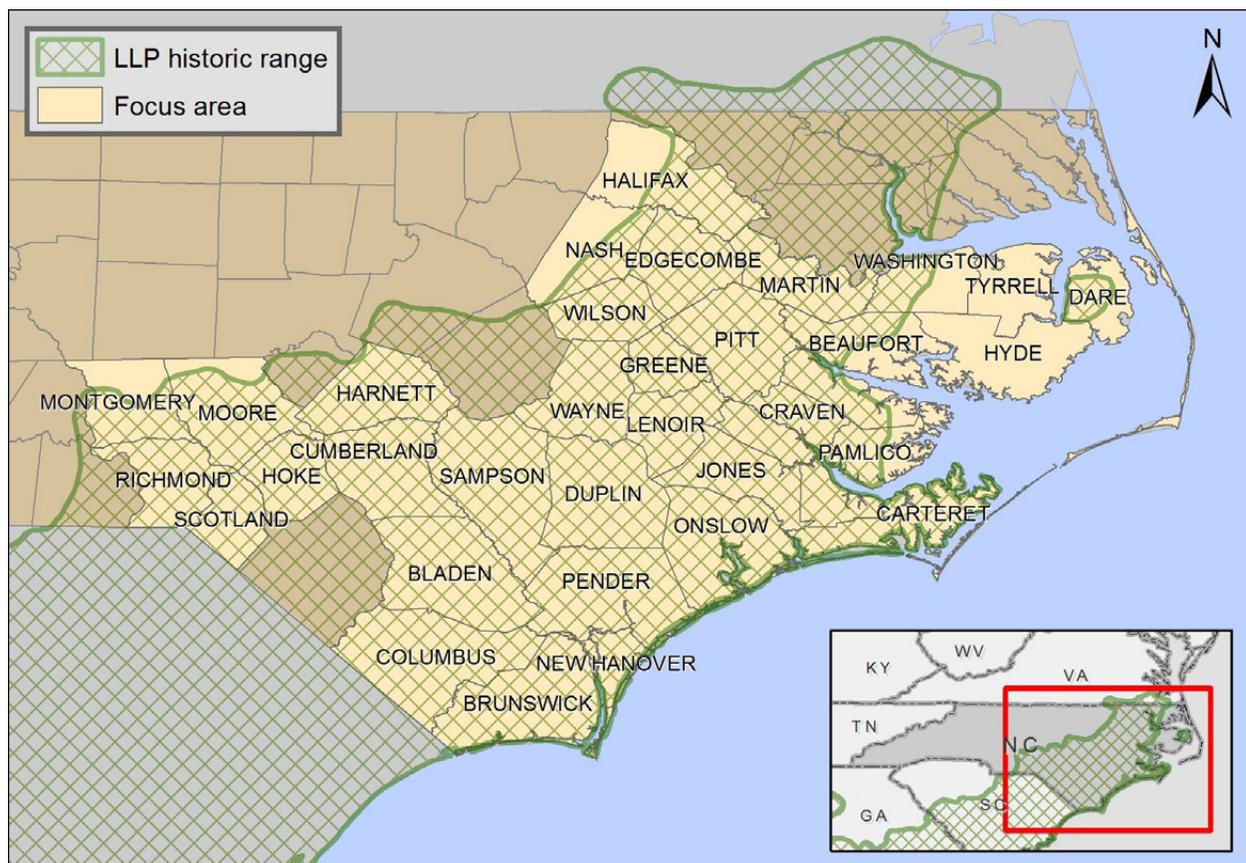


Figure 1—Map of Conservation Innovation Grant Longleaf Pine Project Area.

easements, having management plans, participation in the North Carolina deferred tax program based on agriculture, forestry or wildlife usage [present use value (PUV)], and using Natural Resources Conservation Service (NRCS) and Farm Service Agency (FSA) benefits/cost-share programs. We also included a question on their willingness to participate (WTP) and the amount required to participate (willing to accept, or WTA) in making a permanent conservation easement. Table 1 summarizes the independent variables measured from the survey.

### Statistical Analysis

We analyzed the data using regression analysis and conjoint-based choice analysis. Using these two methods provided a means to triangulate landowner interest and opinions using two approaches, thus providing more robust results.

**Regression analysis**—We analyzed the data from the survey using SAS JMP Pro Version 12.0.1. First, we developed a correlation matrix to examine the relationships of variables measured and identified those with a correlation coefficient with the variable

Interest in a Longleaf Pine Conservation Program (LLPInterest) greater than 0.1. These were organized into four conceptual categories based on landowners’ wealth, past participation in a benefits program, interest in participating in a future credit program, and land characteristics. We then ran separate Ordinary Least Squares (OLS) regressions taking the variable LLPInterest as a function of all the others and recorded their parameter estimates and p-values.

Based on the OLS models and correlation matrices, we used the most impactful variables (those with high coefficients and p-values below 0.05) in a logistic regression model using SAS JMP procedure Nominal Logistic to estimate those that had the most impact on LLPInterest—the likelihood that landowners would be interested in planting or restoring longleaf pine.

The regression model forms then were:

Ordinary Least Squares:

$$P = \beta_0 + \beta_1X_1 + \beta_2X_2 + \dots + \beta_nX_n$$

**Table 1—Independent variables measured**

Variable	Options
LL Cons interest	Yes, No, I don't know
Currently has LLP	Yes, No, I don't know
Present use value registered	Yes, No, I don't know
Receives FSA benefits	Yes, No, I don't know
Receives NRCS benefits	Yes, No, I don't know
Agriculture management plan	Yes, No, I don't know
Forest management plan	Yes, No, I don't know
Conservation Program for Ag Land	Yes, No, I don't know
Forest management plan, who helped	NC Forest Service, NC Wildlife Resources Comm, Consultant, Yourself, Other
Age	Years
Gender	Male, Female
Education	High School, Tech, Associates, Bachelors, Graduate
Acres forest owned	1-49, 50-100, 101-500, 501-999, 1,000-4,999, 5,000+
Acres ag owned	1-49, 50-100, 101-500, 501-999, 1,000-4,999, 5,000+
Income	<\$24,999, \$25-\$49,999, \$50-\$74,999, \$75-\$99,999, \$100,000+
WTP perm easement	Yes, No, Depends on Payments/Property Requirements, Not Sure
WTA perm easement	\$500, \$1,000, \$2,000, \$2,500, Other (please specify)

Logistic Regression:

$$P = \beta_0 X_1^{\beta_1} X_2^{\beta_2} \dots X_n^{\beta_n}$$

where:

P = willingness to participate in a longleaf pine conservation program

X<sub>i</sub> = various land and landowner characteristics

**Choice-based conjoint analysis**—The second part of the survey required respondents to select an ecosystem credit program scenario among those presented in 12 choice tasks. (A choice task consisted of two different randomly generated scenarios and one ‘I don’t know’.) Table 2 shows the five attributes included in each scenario along with their descriptions and possible levels. This portion of the survey, or the choice-based conjoint (CBC) analysis, was analyzed using Sawtooth Software version 8.2.0, Orem, UT. CBC poses questions in a way that reflects how people make choices and enabled us to examine landowners’ underlying values and preferences as they relate to environmental, land use, and economic concerns.

Most of the choice-based conjoint analysis values are self explanatory, including contract length, annual payment, cost-share rate, and assistance level. Obligation covers how the landowner is to manage their land once the contract ends. It has three values: (1) No Obligation = landowners will not be required to maintain any endangered species habitat after the contract ends; (2) Baseline = landowners are NOT obligated to maintain endangered species habitat above the level that existed before the contract started; or (3) Full = landowners must maintain habitat they create until the species have recovered and are delisted.

The cost-share percentage represents the possible program benefits to provide financial compensation to establish the forest.

## Landowner Survey Results

**Descriptive statistics**—Table 3 summarizes the descriptive statistics of the survey data. Respondents averaged 62 years of age and were predominately male (82 percent) and retired (42 percent) or employed full time off property (34 percent). Households with annual earnings of \$50,000–\$100,000 and greater than \$100,000 made up 46 percent and 39 percent of the sample, respectively. While some landowners resided outside of the project area, they would have had to own land or attend conservation programs in the area in order to be included in our survey.

A large share of respondents reported having longleaf pine on their property (58 percent), a forest management plan (68 percent), PUV (68 percent), and to a lesser extent a conservation plan for their agricultural land (28 percent). Finally, 52 percent and 39 percent have participated in a FSA and NRCS benefits program, respectively. These are high rates of longleaf forests and farm programs due to the fact that we obtained our survey samples from existing program participants. This may provide some upward bias in the landowners’ willingness to participate in longleaf programs, but it was unavoidable in order to get an adequate sample, given that we were asking persons to complete a complex survey online.

Table 4 provides a breakdown of respondents by land ownership type. For instance, 80 percent of landowners with 1–49 acres of forest also own 1–49 acres of agriculture land. Similarly, 50 percent of landowners with 1–49 acres of agriculture land also own 1–49 acres of forest. However, there are very few large forest landowners that own large amounts agriculture land. But the large agriculture landowners tend to own large amounts of forest as well. One might expect this because North Carolina is 60 percent forested, and forests will tend to occur in streamside zones, swamps, or hillsides on almost any farm in the State.

**Table 2—Attributes with importance scores and descriptions**

Attribute	Levels	Description
Contract length	5, 10, 20, 30	Number of years required by contract
Obligation	None, Baseline, Full	Landowner’s legal obligation to maintain habitat
Annual payment	\$25, \$50, \$75, \$100	Payment per acre received by landowner
Cost share	25%, 50%, 75%, 100%	Percent of \$300/acre establishment cost
Assistance level	None, Prior Consult, Full Consult	Outside help to manage the land under contract

**Table 3—Descriptive statistics for survey participants**

Survey participants	Completed (244) Started but did not complete (132)
Sex	Male (81.8%) Female (18.2%)
Employment	Full-time (33.6%) Part-time (3.1%) Unemployed (.4%) Disabled (1.3%) Retired (42.4%) Self-employed (19.2)
Education	<High School (.4%) High School/GED (12.8%) Vocational/Tech (10.7%) Associates (14.5%) Bachelors (37.2%) Graduate/Professional (24.4%)
Household earnings	<\$24,999 (4.6%) \$25-49,999 (11.1%) \$50-74,999 (23.6%) \$75-99,999 (22.2%) \$100,000+(38.4%)
Presence of LLP on property	Yes (57.7%) No (28.3%) Not Sure (14%)
Forest management plan	Yes (67.9%) No (29.1%) Not Sure (3%)
Ag conservation plan	Yes (27.5%) No (60.4%) Not Sure (12.2%)
Present use value	Yes (68.1%) No (13.4%) Not Sure (18.5%)
FSA benefits program	Yes (52.1%) No (34.5%) Not Sure (13.4%)
NRCS benefits program	Yes (38.7%) No (50.4%) Not Sure (10.9)
County participant resides	B Bertie (.4%) Bladen (3%) Brunswick (1.7%) Carteret (1.7%) Cabarrus (.9%) Caswell (.9%) Columbus (1.7%) Craven (.4%) Cumberland (10.3%) Dare (.4%) Davidson (.4%) Duplin (2.6%) Halifax (.9%) Harnett (8.6%) Hoke (2.6%) Gatson (.4%) Guilford (.9%) Johnston (6%) Jones (1.3%) Lee (.4%) Lenoir (1.3%) Mecklenburg (1.3%) Montgomery (3.9%) Moore (11.6%) New Hanover (.4%) Onslow (2.6%) Pender (3.9%) Pitt (1.7%) Randolph (1.3%) Richmond (1.3%) Robeson (.4%) Sampson (6.5%) Scotland (1.3%) Union (.4%) Wake (3.9%) Watauga (.4%) Wayne (10.3%) Wilson (.9%)

**Regression analysis**—Tables 5 and 6 provide information on the relationship of those variables that affected interest in longleaf pine conservation programs (LLPInterest). The p-value measures the significance of the results, and generally those less than 0.05 are considered strong, between 0.1 and 0.05 significant, and greater than 0.1 weak. The Logworth estimator provides information about the magnitude of the variable and how much it positively or negatively impacts the dependent variable, in this case LLPInterest.

Table 5 shows that presence of longleaf pine on the landowner’s property, previous participation in a FSA benefits program (FSABenefits), a willingness to participate in a permanent easement to promote longleaf pine (a yes or no answer, depending on the property requirements; variable WTP Depends on Property Requirements), the actual required amount to accept a permanent easement (\$2,500), and ownership of 101–500 acres of forest positively impacted landowners’ interest in a conservation credit program to promote longleaf pine habitat. Conversely, Table 6 shows that those less likely

to be interested included persons who were unwilling to participate in a permanent easement.

These all make intuitive sense—existing program and FSA participants were likely to be interested in longleaf programs as well, and higher payments for easements would encourage more participation. Owners with medium-sized forest tracts of 101–500 acres were the most likely to be interested; small and large forest owners were not. However, ownership size of agricultural land had no effect on interest in program participation. Similarly, education, employment, income, gender, having forest or farm management plans, and/or being enrolled in PUV programs had no effect on landowners’ interest in participation. NRCS program participation may have been influential as well, but less so than FSA use, so it was eliminated in the first OLS regressions in order to avoid a high correlation between independent variables in the logistical regressions.

**Choice-based conjoint analysis**—The CBC analysis provides insight into how landowners prioritize the

**Table 4—Land characteristics of survey participants**

Forest landowners by acres with agricultural land							
Acres of ag	1-49	50-100	101-500	501-999	1000-4999	5000+	
1-49	80%	33%	37%	26%	19%		
50-100	15%	39%	30%	26%	14%		
101-500	5%	26%	27%	32%	48%	100%	
501-999		2%	5%	11%	10%		
1000-4999			2%	5%	10%		
5000+							
						<b>Total</b>	
Forest owners with ag / total forest owners	59/84	51/69	60/92	19/23	21/29	2/2	<b>210/299 (70.2%)</b>

Agriculture landowners by acres with forests							
Acres of forest	1-49	50-100	101-500	501-999	1000-4999	5000+	
1-49	50%	16%	6%				
50-100	18%	36%	26%	13%			
101-500	23%	33%	32%	38%	25%		
501-999	5%	9%	12%	25%	25%		
1000-4999	4%	6%	20%	25%	50%		
5000+			4%				
						<b>Total</b>	
Ag owners with forest / total ag owners	95/103	55/57	50/50	8/8	4/4		<b>212/222 (95.5%)</b>

**Table 5—Positive significant variables, LLPInterest**

Variable	P-value	LogWorth	Est.
CurrentLLP (Yes)	0.00459	2.338	0.5154
WTA (\$2,500)	0.01828	1.738	0.4983
FSABenefits (Yes)	0.03864	1.413	0.3805
WTP (Depends Property Req.)	0.04367	1.36	0.4917
Acres Forest (101-500)	0.10482	0.98	0.3374

**Table 6—Negative LLPInterest correlation**

Variable	P-value	LogWorth	Est.
WTP (No)	0.00006	4.23	-0.8093

program scenario attributes by assigning relative importance scores to each, as seen in Table 7. A higher score represents a greater value placed on the attribute by the respondents. Contract length, level of obligation, and annual payments were identified as the most important factors to landowners. Conversely, cost share and technical assistance level both scored comparatively low.

This CBC analysis also enables us to examine how values within each attribute fared by providing total zero-centered utility values for each (only levels within an attribute can be compared), as seen in figure 2. Again, higher scores represent a greater preference by the survey respondent. Respondents showed a steady decreasing preference for greater contract lengths. Preference steadily increased with greater assistance levels, cost-share percentages, and incentive payment amounts. Obligation preference decreased slightly between no obligation and baseline obligations, but dropped radically for full obligation.

### CONCLUSIONS

Landowners were most influenced by contract length and legal obligation in a conservation contact. Short-term contract agreements of 5 to 10 years were favored, as were the least land restrictions. Annual payments were somewhat less important than contract agreement or level of obligation, although higher payments were more desirable, as expected. The initial cost-share rate and level of technical assistance were the least important

**Table 7— Choice-based conjoint (CBC) attributes with importance scores**

Attribute	Score
Contract length	28.40%
Obligation	25.90%
Annual payment	20.80%
Cost share	12.40%
Assistance level	11.40%

factors affecting willingness to participate in longleaf conservation programs. The presence of longleaf pine on the landowner’s property, previous participation in a FSA benefits program, a willingness to participate in a permanent easement to promote longleaf pine, the amount required to accept a permanent easement, and ownership of 101–500 acres of forest positively impacted landowners’ interest in a conservation credit program to promote longleaf pine habitat. Conversely, persons who were unwilling to participate in a permanent easement were less interested.

Although our findings suggest contract programs could generate more supply of longleaf, additional funding from Government or private organizations would be needed to support such contracts. So far, moderate Federal and State longleaf incentives have been successful and well subscribed, but more funds and perhaps higher payment

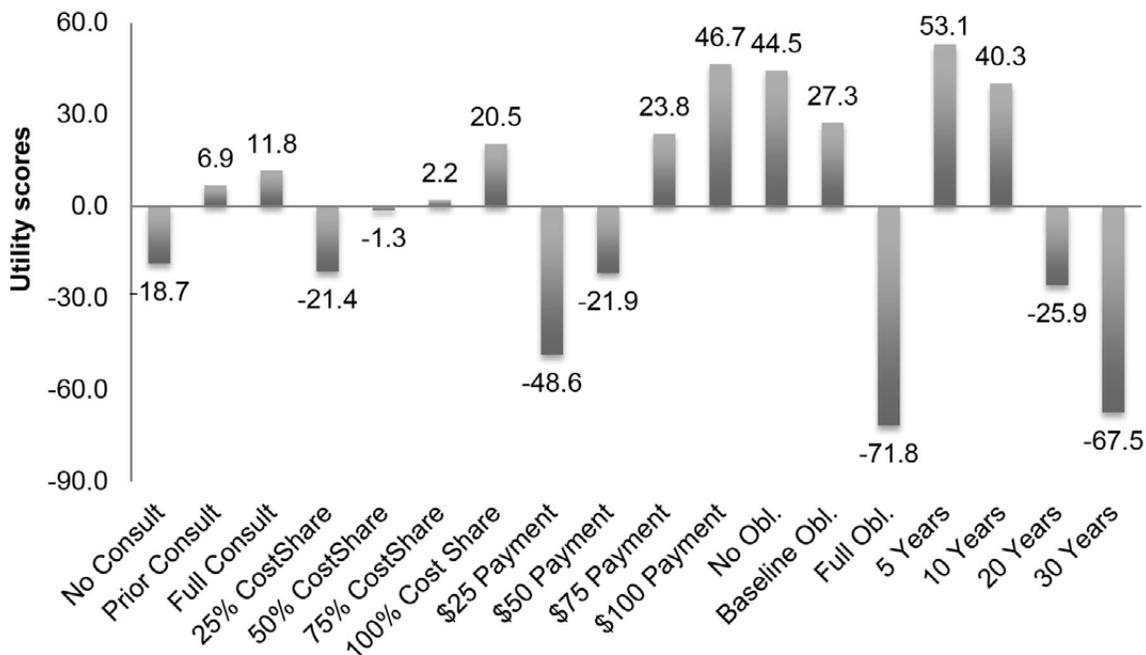


Figure 2—Utility scores for choice-based conjoint (CBC) attributes.

levels are needed to increase the supply. The modest regulatory demand and still nascent voluntary demand for longleaf ecosystems will probably continue to prompt a slow expansion in longleaf pine establishment and restoration in North Carolina rather than a quantum leap that might be prompted by a program such as the Federal “No Net Loss of Wetlands” policy that was mandated in 1990.

We see several avenues for future research in this arena. First, additional studies may explore the relative importance of longleaf’s economic merits compared to loblolly pine for landowners. Possible advantages may include alternative income streams (e.g., pine straw, poles) and higher tolerance of drought, wind, and flooding. Similarly, future research could include a spatial component. Compared to loblolly pine or crops, it provides a different income stream and markets for risk reduction purposes; it may prosper more in droughts or even floods; and it provides broad ecosystem benefits. It also does provide pine straw as well as superior timber and poles, and could thus potentially produce higher returns than managing for loblolly pine (Dickens and others 2012), especially with payments from incentive programs for the first 10 years after stand establishment. If a credit ranking system is developed, setting minimum conservation benchmarks and priorities for selecting the best lands—e.g., large areas, near existing RCW colonies—would be important. Even for more traditional incentive programs, these location and habitat characteristics could be incorporated more in making funding decisions.

Our specific results also can be complemented by knowledge of existing landowner behavior. Landowners have been more than willing to enroll in Farm Bill and State longleaf pine planting programs, and our findings help suggest preferred contract, payment, and assistance factors. While it is anecdotal, it appears that a recent increase in tree planting in the South also has a much larger longleaf pine component than in the past, providing some evidence that these public assistance programs are increasing longleaf habitat.

Other practical factors—such as likelihood that longleaf is harder to plant and manage than loblolly, or that agriculture returns on poor lands have such huge variations and much higher risk—may also have large negative or positive impacts on economic decisions to whether to plant or restore longleaf. Getting the message right, making applications easy, and providing certainty to landowners that any program strings will not escalate all are important factors that could provide fodder for future projects to increase the area and restoration of longleaf pine.

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