Incentives for Biodiversity Conservation on Non-Industrial Private Forests: An Analysis of Landowners’ Participation

Jagannadha Matta¹, Janaki Alavalapati² and Evan Mercer³

Abstract

Although non-industrial private forests (NIPF) provide significant habitat for a variety of species, limited information is available on how landowners would respond to the adoption of practices that promote biodiversity conservation on their lands. We examined NIPF landowner preferences for adopting four such practices—extending timber rotation age, extending riparian buffer strips, periodic prescribed burning, and invasive species control—through a survey of forestland owners in Florida. Employing an attribute-based choice experiment technique, we analyzed how landowners’ willingness to enroll in various incentive programs are influenced by their socio-economic characteristics and by the program attributes. Results of the multinomial logit model indicate that landowners with higher income, education, and more years of forestland ownership are more willing to adopt the suggested forest practices. Besides providing valuable insights in designing optimum incentives to further wildlife habitat on NIPF lands, the results of this study also underline the need for enhanced education and outreach efforts on these practices for increasing landowner participation.

¹Post-doctoral Associate, School of Forest Resources and Conservation, University of Florida, Gainesville, FL 32611. Email: raojm@ufl.edu
²Associate Professor, Forest Policy and Economics, School of Forest Resources and Conservation, University of Florida, Gainesville, FL 32611. Email: janaki@ufl.edu
³Research Economist, US Forest Service, Southern Research Station, PO Box 12254, RTP, NC, 27709. Email: emercer@fs.fed.us
1. Introduction

Forests in Florida comprise over 6.5 million hectares and contribute over $7 billion annually to the state’s economy (Carter and Jokela 2002). NIPF owners own about half of these lands. Besides providing invaluable economic, social, recreational, and environmental services, these NIPF are also home to several threatened and endangered species such as the red cockaded woodpecker, gopher tortoise, and flat wood salamander. Owing to several development pressures, however, many of these lands face a high risk of habitat degradation (Kautz and Cox 2001) and a variety of management practices are suggested to promote forest health and habitat for wildlife on these lands. Prominent among these practices are periodic prescribed burning, removal of invasive species, delaying timber harvesting beyond the financially optimal rotation age, and creation and/or maintenance of streamside management zones (SMZ) to protect riparian buffers (Matta and Alavalapati, forthcoming).

The thrust for fostering the adoption of the above four biodiversity-enhancing management practices mostly comes from the societal benefits they produce. Delaying timber harvesting and maintaining extended riparian buffers to improve habitat for wildlife on NIPF were also suggested earlier in contexts elsewhere (e.g. Kline et al 2000a and 2000b). Wildfires are a recurrent phenomenon in pine forests in Florida for thousands of years and there is a perception that fire suppression in recent years has significantly impacted the native forest ecosystem (Long 2002). Consequently, periodic prescribed burning is advocated as a major mechanism to protect and restore native flora and fauna. Similarly, invasion of alien species is widely recognized as a major threat to the ecological integrity of native ecosystems (Jose et al. 2002).

Past studies on the prevalence of these practices indicate that very few landowners actually pursue them. For example, the SFRA (2002) report indicates that only about 11% of the landowners in the US South undertake practices that improve wildlife habitat. Specifically with regard to NIPF in Florida, English et al. (1997) noted that less than a third of large (40+ hectare) landowners implement practices designed to enhance timber growth, improve wildlife habitat, protect water quality, and/or enhance scenic values. Protection of wetlands was also cited as the least frequently used conservation practice by these landowners. Further, Jacobson (1998) observed that about 47% of NIPF owners in Florida were not actively managing their lands. One of the reasons for not actively managing forestlands was the investment cost needed for their active management (Jacobson 1998). In fact, the SFRA (2002) report observes that doing nothing is considered to be a practical and cost-effective approach for many landowners. There is, however, a possibility of landowners agreeing to follow biodiversity-enhancing management practices if they are offered economic incentives (Shogren et al. 1999). In this paper we develop a predictive model to understand landowner participation in such an incentive program and estimate corresponding willingness-to-accept (WTA) values.
Other significant factors that often determine the effectiveness of a conservation program are the number and distribution of land parcels that get enrolled (Parkhurst et al. 2002). Besides effectiveness from a biological point of view, when a larger number of landowners in a specific area participate, implementation and monitoring costs per landowner could be lower. From an individual landowner point of view, the costs and risks, if any, associated with implementing the program to him/her may be smaller with higher participation rates due to the ability of nearby landowners to exchange information and experiences. Particularly, for practices such as prescribed burning and invasive species control, the unit costs of implementing them would be lower when a larger number of landowners enroll. Therefore, we were interested in examining if the number of participating landowners in a program influences landowner decision on his/her participation. Accordingly, we have also included variables representing this dimension in our model.

The objective of this paper is to examine the willingness of landowners to adopt such biodiversity-enhancing management practices. Specifically, using data from a survey of NIPF owners in Florida, we analyze how land, landowner, and program characteristics influence NIPF landowner participation in an incentives program designed to provide habitat for biodiversity.

Past studies indicated how different program characteristics influence landowner participation. However, these studies have not examined how landowner preferences vary with different combinations of characteristics of incentive program alternatives. By focusing on program characteristics and associated utility measures, this paper provides critical information on not only the attributes of a conservation program that attract landowners most but also the extent of incentive payment involved for various alternatives. Of late, several states are developing comprehensive regional wildlife conservation plans specifically to provide habitat for rare and threatened species at landscape levels. This paper could help improve the success and sustainability of such efforts by providing a mechanism to identify program elements that would ensure effective participation of landowners. The remainder of the paper is organized as follows. Section 2 presents the conceptual framework of the model. Section 3 details the data collection methods and analysis. In Section 4, results are presented and finally, a summary and policy implications of the findings are presented in Section 5.

2. Conceptual Framework of the Model

In an ACE design, the products or services tested for respondents’ preferences are presented as sets of distinct attributes (or features) with variations (or levels) in each attribute (feature). This allows the researcher to capture the trade-offs people make between the attributes of alternative goods and services and their levels and estimate the probability of people choosing different attribute combinations (Louviere 1988; 1994). In analyzing the adoption potential of the proposed four biodiversity enhancing practices, for example, the landowners evaluate trade-offs associated with each practice, as well as different levels within a practice. As such, the ACE technique can be used to assess how landowners prefer different attributes of the management practices, what economic and
non-economic criteria influence their preferences, and finally, determine the characteristics of a conservation package that would most likely be adopted.

Following Holmes and Adamowicz (2003) and Shrestha and Alavalapati (2004), we applied the attribute-based choice experiment (ACE) design to model and analyze landowner decision to participate in a conservation incentive program and estimate the corresponding WTA values. Random utility theory (McFadden 1974) provides the theoretical basis for attribute-based choice experiment (ACE) modeling and value estimation. The technique uses repeated choice process in value elicitation and analyses respondent’s choice preferences. The basic assumption underlying the theory is that the true but unobservable utility of a good or service \( j \) is composed of both deterministic \((v)\) and random components \((\varepsilon)\). Applying this technique to our study, we consider each attribute (management practice) of the conservation program as an alternative \( j \) in a choice set \( C \). The alternative \( j \) is a specific alternative representing a change in management with its conditional indirect utility level \( U_j \) for a landowner and is expressed as:

\[
U_{ij} = v_{ij} + \varepsilon_{ij}
\]

The selection of alternative \( j \) over alternative \( h \) implies that the utility of \( U_{ij} \) is greater than that of \( U_{ih} \). The utility is random as while the respondents know with certainty their choices, the researcher’s knowledge is stochastic since it is based only on the observed behavior of respondents during the choice experiment. Accordingly, the probability of an individual \( i \) choosing alternative \( j \), \( p(\cdot) \), is expressed as:

\[
p(ij|C) = p[U_{ij} > U_{ih}] = p[(v_{ij} + \varepsilon_{ij}) > (v_{ih} + \varepsilon_{ih})], \quad j \neq h
\]

Assuming that the error terms of the utility function are independently and identically distributed (IID) and follow a type 1 extreme value (Gumbel) distribution and the choice probabilities have a closed-form solution, they are estimated using a multinomial logit (MNL) specification (Shrestha and Alavalapati 2004). The MNL model indicating the probability of choosing an alternative \( j \) (whose utility is greater than the utility of all other alternatives) is represented as:

\[
p(ij) = \frac{\exp{\mu v_{ij}}}{\sum_{q \in C} \exp{\mu v_{iq}}} (3)
\]

where \( \mu \) is a scale parameter.

If utility \( U_{ij} \) is assumed to be linear, additively separable, and \( \mu = 1 \), it can be represented as

\[
U_{ij} = \mu (\beta_1 z_1 + \beta_2 z_2 + ... + \beta_n z_n + \beta_{s1} s_1 + \beta_{s2} s_2 + ... + \beta_{sk} s_k)
\]
where \( \beta \) is a constant term that can be partitioned into alternative specific constants (ASC), and \( \beta_n \) is the vector of coefficients attached to the vector of program attributes \( z \), and \( \beta_m \) is the vector of respondents’ individual characteristics \( s \) that influence utility.

We believe that the application of ACE technique is a major improvement from previous studies that mostly looked at whether a landowner participates in a program or not. The ACE technique goes a step forward by providing a predictive understanding of landowners’ forestland use decisions and the relative importance of the characteristics of an incentive program desired by them. As such, results of this approach would be more valuable to program planners and conservation agencies in designing appropriate incentive policies and targeting specific potential participants.

3. Data and Analysis

This section describes the survey procedure followed to obtain the data. The names and addresses of NIPF landowners in 4 counties (Alachua, Putnam, Walton, and Bay) in north Florida who owned at least 10 acres of land were obtained from county tax assessor’s offices. A mail survey was designed and conducted according to the Total Design Method (Dillman 1978) in the spring and summer of 2005. Several steps were taken to facilitate easy understanding of the items presented in the survey. These include a 4-page information brochure that provided brief descriptions about the role of NIPF in wildlife conservation, conservation incentive programs, and the specific management practices for which landowners’ willingness to adopt were being sought. Color photos and drawings of these practices were also used to illustrate them clearly. The initial survey was pre-tested with focus groups of NIPF landowners. After incorporating the changes suggested by the focus groups, the surveys were mailed out to a random sample of 1,500 landowners. A reminder postcard and a second mailing followed the first mailing. Of the original 1500 surveys mailed out, 221 surveys could not be delivered. Of the 1279 delivered, 513 were returned, which gives a response rate of 40.1%. This response rate is within the range of response rates reported earlier for similar valuation surveys (Loomis et al. 2000). Of the 513 surveys that were returned, 400 were considered usable.
The survey asked NIPF owners questions about characteristics of their property, past management practices, knowledge of incentives programs, and demographic information. In addition, the survey presented landowners hypothetical incentive programs in 4 choice sets. Each choice set had two options (A, B) representing different combinations of proposed conservation program options and a status-quo option (C), representing current management options. The respondent was asked to choose one of these three options (Figure 1).
Table 1: Definitions of program attributes used for choice experiment

<table>
<thead>
<tr>
<th>Program attributes</th>
<th>Levels in each attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>b. Harvesting is permitted only after trees are 30 years</td>
</tr>
<tr>
<td></td>
<td>c. Harvesting is permitted only after trees are 50 years</td>
</tr>
<tr>
<td>2. Maintaining Streamside Management Zone (SMZ)</td>
<td>a. No change to existing SMZ (at least 35 feet).</td>
</tr>
<tr>
<td></td>
<td>b. Requires an SMZ of at least 100 feet width.</td>
</tr>
<tr>
<td></td>
<td>c. Requires an SMZ of at least 200 feet width.</td>
</tr>
<tr>
<td>3. Conducting prescribed burning</td>
<td>a. No requirements for conducting prescribed burns.</td>
</tr>
<tr>
<td></td>
<td>b. Conduct prescribed burns at least once in 2-3 years.</td>
</tr>
<tr>
<td></td>
<td>c. Conduct prescribed burns at least once in 4-6 years.</td>
</tr>
<tr>
<td>4. Invasive species control</td>
<td>a. No requirements for invasive species control.</td>
</tr>
<tr>
<td></td>
<td>b. Control measures required every 2 to 4 years.</td>
</tr>
<tr>
<td></td>
<td>c. Control measures required every 5 to 7 years.</td>
</tr>
<tr>
<td>5. Landowner participation in the program</td>
<td>a. Less than 1% of landowners in your county enroll.</td>
</tr>
<tr>
<td></td>
<td>b. 10% of landowners in your county enroll.</td>
</tr>
<tr>
<td></td>
<td>c. About 20% of landowners in your county enroll.</td>
</tr>
<tr>
<td>6. Incentive payment (per acre/year)</td>
<td>$10, $20, $40, $70</td>
</tr>
</tbody>
</table>

In each attribute, level “a” indicates status quo, level “b” moderate level, and level “c”, higher level of restrictions.

Different combination of management practices (attributes) in each of the proposed new option (A or B) in fact represent different levels of the practice and an incentive payment in the form of an annual payment. Each attribute had three levels and the incentive payment four levels (Table 1). In arriving at different combinations of attribute levels in options A and B, we used a random selection process, which is said to generate more precise valuation estimates compared to fractional factorial design commonly used in ACE technique (Lusk and Norwood 2005). Moreover, this random design process allows for detailed examination of attribute interactions beyond main effects.

Data Coding and Model Estimation

As described above, each choice presented in the questionnaire required the respondent to choose one of the two conservation program alternatives to adopt or opt status quo. The respondent repeats this process for four different choice sets. Thus, for each respondent we obtained 12 (4 x 3) data points. An alternative specific constant (ASC) for the status quo option was created by assigning a value of “1” if that line of data described the status quo alternative and “0” otherwise. Variability in choice selection not explained by the attribute or socio-economic variables is captured by ASCs (Holmes and Adamowicz 2003). Effects codes using “1”, “-1”, and “0” were used to code the variables for the attribute levels. For all our attributes, which have three levels each, the status quo level is chosen as the base and two effects codes variables were created for the other two levels.
The coefficients for these two levels are estimated from the model and the parameter value for the omitted attribute is the negative sum of these coefficients. LIMDEP (1999) discrete routine was used to estimate the resulting multinomial logit regression model (MNL). A detailed overview of data coding and model estimation is provided by Holmes and Adamowicz (2003).

4. Results and Discussion

Descriptive statistics for the study sample indicate that the average sizes of the landholding and forestland are 244.5 and 200.8 acres respectively. The properties are located on an average about 33.3 miles from the nearest city having a population of 50,000 or more. Pine forests are dominant, occupying on an average 45.7% of the forestlands. Wetlands, canals, and other water bodies occupy about 9.8% of the forests while mixed forests and hardwoods constitute 28.1% and 7.5% of them respectively. The average landowner is 61 years old, has owned land for 37 years, received college level education, and earned an annual income of $74,649, much above the average household income of Florida residents ($53,030) in 1999. A majority (78%) of the respondents are male. While 58% of them have residences on their property, it is interesting to note that for 98% of the respondents, forestry is not a major source of income. Only 15% are members of a forestry or conservation organization. Land investment is the most important objective of forestland management for 36% of the respondents, which is followed by timber production (20%), wildlife (14%), aesthetics (13%), and other purposes.
Socioeconomic variables are interacted with the alternative specific constants (ASC).

We estimated the multinomial logit model and tested for IIA restrictions using the Hausman and McFadden test. The test results did not indicate any violation of IIA assumption. Parameter estimates for the base case attribute (status quo) levels were computed as the sum of -1 times the parameter values for the included levels of each attribute. The coefficient on the status quo Alternative Specific Constant (ASC), which indicates the marginal utility of the status quo relative to the proposed program alternatives is significant (5% level) and positive (Table 2). This indicates that, everything held constant, landowners prefer maintaining the status quo to participation in the proposed program.

Coefficients on attribute variables however indicate interesting results demonstrating each practice’s effect on landowners’ utility function. For example, the forest practice attribute coefficients $HARV50$, $BUFF200$, $BURN2$, $BURN5$, $INV6$ are negative, indicating negative utility to landowners. These practices in fact represent restrictions on management and as such, carry a negative utility with them. Of these five coefficients, however, only those that represent the higher form of restriction- $HARV50$ (no harvesting till the age of 50 years) and $BUFF200$ (maintaining a minimum streamside management zone of 200’ width) are significant at $p<0.01$, clearly implying that higher regulations reduce landowners’ utility associated with adopting these practices. The coefficient for...
incentive payment \textit{INCENT}, is positive and significant (p<0.01) indicating that incentive payment increases landowners’ utility. The percentage of landowners participating in a county did not show any significant effect on individual landowner participation.

The individual-specific variables were interacted with alternative specific constant term (\textit{ASC}). It is interesting to note that the coefficient for the variable \textit{AGE} is positive and significant indicating that the probability of choosing the status quo, everything else held constant, increases if the respondent is older. On the other hand, the variables representing \textit{EDU, INC, YEARS}, are negative and significant suggesting the probability of choosing status-quo decreases if the respondent holds a college degree, has higher income, and owned the land for a longer time. The coefficients for variables \textit{MILES, RES} and \textit{ORG} are also negative and significant which suggests a decrease in the probability of choosing status quo if the property is located farther from a city, if the respondent has residence on property, and if he/she is a member of a forestry or conservation organization. When analyzed together, these results suggest a plausible pattern explaining landowners’ participation in an incentive program designed to improve habitat for wildlife. There seem to be a set of landowners holding forestlands close to cities as capital investments and reluctant to participate in forest/wildlife management programs. These are relatively older people, have their main residences located elsewhere from forest property, and are not associated with any forestry or conservation organization.

5. Summary and Conclusions

With the increasing concerns for healthy forests and enhanced habitat for wildlife, private landowner involvement has become a critical component of biodiversity conservation in the US. This study examines the willingness of non-industrial private forest owners of Florida to adopt a conservation program that requires following restrictions beyond the existing BMPs under certain financial incentives. Applying an attribute-based choice experiment design, we assess the adoption potential of the identified biodiversity-enhancing management practices. The results also suggest that younger landowners with higher income, education, and more years of forestland ownership would be more willing to adopt the suggested forest practices. There is also an increased probability of landowner participation if the property is located farther from city, if the respondent has residence on the property, and if he/she is a member of a forestry or conservation organization. While considering these results, however, one has to bear in mind the dynamic nature of NIPF community, particularly as it applies to the southeastern US. Florida has been identified as one of the fastest growing states in terms of residential development in the US and forest areas and rural lands are the primary targets for such alternative land uses. In addition, a significant decline in NIPF tree planting in the US South in the next 50 years is predicted owing to increased plantation costs and reduced levels of external assistance (Kline et al. 2002). There has also been a steady decline in pulpwood and sawtimber prices in this region significantly impacting the profitability of forest management geared toward producing these products. Under these circumstances, a forest landowner’s prime motive would be to adopt a land use strategy that maximizes his/her net returns. These factors perhaps explain why there is reluctance on the part of some landowners to undertake these practices. They also provide an empirical basis or
justification for extending financial incentives to landowners to ensure the sustainability of family forests in the long run. With the growing importance of science-based policy making, we believe that the landowner attributes and cost estimates provided in the study would be of significant value to all those individuals and organizations interested in furthering biodiversity on NIPF.

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References:


