Journal of Agricultural and Applied Economics, 36,3(December 2004):763–772

Effect of Ranchland Attributes on Recreational Hunting in Florida: A Hedonic Price Analysis

Ram K. Shrestha and Janaki R.R. Alavalapati

Recreational hunting has been an attractive enterprise for some ranchers who are interested in supplementing their income from cattle. Ranchland attributes—such as parcel size, tree cover, and proximity to urban centers—are expected to influence hunters' preferences and, thus, hunting lease payments. We estimated the effects of these attributes on hunting revenues using a hedonic model. The results reveal that trees and vegetation cover on ranchlands have a positive impact on hunting revenues, indicating opportunities for silvopasture practices. Those ranchers in Florida who maintain about 22% trees and other vegetation cover receive $16.15 per acre per year from hunting leases, but doubling the cover would generate only an additional $3.20 per acre per year.

Key Words: hedonic model, hunting lease, land attributes, silvopasture

JEL Classifications: Q23, Q24, Q26, Q51, Q57

Cattle ranching in combination with trees and forage production is a relatively new farming practice in the southern United States. This integrated farming system, which is often called "silvopasture" in agroforestry literature (Clason and Sharrow), generates various environmental benefits such as water quality improvement, soil conservation, carbon sequestration, and aesthetic value (Alavalapati and Nair; Clason and Sharrow; Kurtz). Furthermore, silvopasture practices may provide better habitat for wildlife such as the crested caracara (*Caracara cheriway*), an endangered bird that inhabits ranchlands of south-central Florida (Morrison and Humphrey).

Rural lands with wildlife habitat, recreational opportunities, and scenic views are often valued more than those dominated by agricultural production. Using geographic information system data from 1989–1995 in Wyoming, for example, Bastian et al. estimated values for environmental amenities of remote agricultural lands and found that variables such as scenic view, wildlife habitat, recreational use, and distance to town were significant determinants of land prices.

Private ranchlands in Florida support habitat for game and nongame species such as white-tailed deer, wild hog, turkey, sandhill

Ram K. Shrestha is postdoctoral research fellow and Janaki R.R. Alavalapati is associate professor in the School of Forest Resources and Conservation, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, FL.

We thank Cynthia Wilkerson for assisting us with survey development and administration. The manuscript greatly benefited from comments provided by two anonymous reviewers and the Editor, John B. Penson, Jr. Any errors found are the sole responsibility of the authors.

This research was made possible by the financial support from the United States Department of Agriculture (Initiative for Future Agriculture and Food Systems) and the Florida Agricultural Experiment Station.

Florida Agricultural Experiment Station Journal Series R-10188.

crane, and burrowing owl (Morrison and Humphrey; Swisher et al.). In recent years, some ranchers in Florida have benefited by managing their lands for recreational hunting. This is also a supplemental economic activity for many rural landowners, wherein they sign a lease with hunting clubs or other interested parties for the recreational hunting use of their lands (Guynn and Busch; Johnson; Livengood; Mullin; Stribling).[1] Although there is no formal market for hunting leases, 83% of southern landowners leased some of their timberlands in 1984 (Guynn and Busch). By leasing hunting rights, landowners receive sizable payments in terms of annual user fees. For example, landowners in the coastal plains of South Carolina received a hunting fee or price ranging from $0.50 to $10 per acre per year in 1984, twice as much as they received in 1979 (Guynn and Busch). Similarly, landowners in Alabama received a hunting fee anywhere between $3 and $20 per acre per year in 1995 dollars (Johnson), whereas Texas landowners received between $100 and $2,000 per gun, which corresponds to $0.25–$10 per acre per year in early 1980s (Livengood). The lease arrangements between landowners and lessees are made in various ways, including annual or seasonal leases, day hunts, animals bagged, or leasing established through hunting clubs (Pope and Stoll).[2]

Demand for recreational hunting is substantial in the United States. In 1994–1995, more than 30 million people (≥16 years old) participated in recreational hunting activities (Cordell et al.). In 1996, the top 15 states issued more than 8.36 million hunting licenses (Baen). With a large population of hunters and limited quality hunting opportunities on public lands, these private lands offer excellent opportunities to satisfy the demand of recreational hunters. A variety of factors would affect the demand for hunting leases. For example, restrictions on the lease—such as comprehensiveness and transferability—services offered to facilitate the transaction, and site characteristics—such as wildlife habitat quality, forested area, tract size, game species diversity, and accessibility—have been shown to influence hunting lease prices (Johnson; Pope and Stoll). In fact, the James River Pulp and Paper Company developed pricing strategies for hunting leases in 1989 that accounted for different land characteristics, such as tract size, habitat diversity, access, proximity to population centers, and hardwood acreage (Johnson).

Guynn and Busch reported that hunting clubs in the early 1980s were interested only in larger parcels of land, exceeding 1,000 acres, for hunting leases. As the demand for hunting leases increased, smaller tracts also became attractive. According to Pope and Stoll, lease price is expected to vary on the basis of services offered, game species, quantity and quality of wildlife, aesthetic appeal of landscape, parcel size, and distance from an urban center. Therefore, information about the effects of many of these attributes on hunting lease prices may be critical for optimal land management decisions.

Several studies have assessed the marginal impact of natural attributes on hunting revenues, using hedonic price models (Livengood; Messonier and Luzar; Pope and Stoll). Livengood estimated marginal willingness to pay for white-tailed deer hunting on leased land in Texas using 1978–1979 survey data and found that the demand for hunting leases was nearly unitary elastic. His results show a positive relationship between the number of game harvested and parcel size on lease prices. Similarly, Pope and Stoll reported that lease price was significantly related to the number of acres in the lease and distance to the nearby metropolitan area. However, none of the services and facilities variables, except the pro-

[1] Hunting leases are fairly recent phenomena in the United States, practiced only after the 1930s, when the first formal lease appeared in central Texas (Baen). Private farms, ranchlands, and forests cover approximately 66% of total land area and support 80% of wildlife habitat in the United States (Benson), thus showing hunting leases as a potential tool for wildlife management.

[2] The license or fee hunting represents only a portion of the total recreational hunting demand (Jones et al.; Thurow et al.). Jones et al. found that a substantial percentage of hunting activities in Mississippi occurred without paying fees.

vision of a cabin onsite, had a significant impact on lease prices.

Since the seminal paper by Sherwin Rosen in 1974, hedonic models have been extensively used to derive implicit values of natural attributes (Freeman; Lansford and Jones; Rosen). These models assume that prices are determined under market-clearing conditions and are uniquely associated with structural and spatial attributes of the good (Poor et al.; Rosen). In the present study, we use a hedonic price model to estimate the implicit values of selected natural and spatial attributes of Florida's ranchlands. In particular, we hypothesize that trees and other vegetation cover would have a positive impact on hunting lease prices. If we cannot reject this hypothesis, silvopasture that combines trees and other vegetation with cattle ranching can be a potential land-use option to improve income for ranchers and environmental quality to the society at large. With more than 6 million acres of ranchlands (Florida Agricultural Statistics Service; Florida Cattlemen's Association), Florida ranks 10th in the United States and third in states east of the Mississippi River for beef cattle herd size (Wade, Minton, and Delargy), which indicates a strong potential for developing silvopasture practices in the state.

Methodology and Research Design

Hedonic Method and Model Specification

Under market clearing conditions, the relationship between prices and environmental quality or quantity attributes of a good may be specified as follows

$$(1) \quad P(Z) = F(Z_1, \ldots, Z_n),$$

where $P(Z)$ is the implicit value for attribute Z_i ($i = 1, \ldots, n$). Here Z_i can represent a spatial, managerial, and natural attribute of ranchlands. The resulting marginal implicit value can be determined as

$$(2) \quad \hat{P}_i = \partial P(Z)/\partial Z_i.$$

When supply and demand functions are assumed to be independent of price and weakly separable in Z_i, quantity and/or quality attributes can be entered as exogenous variables. This would allow us to estimate the demand model using the hedonic price function specified in Equation (1). This is a short-run characterization of the market equilibrium as interpreted by Rosen. Furthermore, assuming income independence (homothetic preferences), Willig showed that the implicit price estimate provides a consistent measure of welfare change (Freeman; Milon, Gressel, and Mulkey).

Choice of the functional form of the hedonic price model is extensively discussed in applied economic literature (Faux and Perry; Freeman; Livengood; Milon, Gressel, and Mulkey). Box-Cox transformation is a commonly used approach to identify an appropriate functional form (Faux and Perry; Milon, Gressel, and Mulkey). In this procedure, the implicit value function can be expressed as

$$(3) \quad P(Z)^{\lambda_1} = \beta Z^{\lambda_2} + \varepsilon,$$

where β is a matrix of slope coefficients and ε is normal error term that is assumed to be independent and identically distributed. Furthermore, $P(Z)^{\lambda_1}$ and Z^{λ_2} can be represented as the Box-Cox transformation of the form

$$(4) \quad y^{\lambda_i} = \begin{cases} (y^{\lambda_i} - 1)/\lambda_i & \lambda_i \neq 0, \quad y > 0 \\ \ln y & \lambda_i = 0, \quad y > 0, \end{cases}$$

where y is a variable that is to be transformed. The most appealing feature of the Box-Cox transformation is that it requires no prior restrictions on the price-attribute relationships. Different values of λ_1 and λ_2 and resulting parameter values would describe the functional forms that best fit the data. For example, a value of $\lambda_1 = \lambda_2 = 1$ suggests a linear functional form, whereas a value of $\lambda_1 = \lambda_2 = 0$ suggests a double-log form (Faux and Perry; Milon, Gressel, and Mulkey).

Following the Box-Cox functional form, a hedonic price model can be specified as a function of ranchland attributes that include quantity measures (Z_i), natural attributes (E_i), and managerial interventions (M_i)

$$(5) \quad P^{\lambda_1} = \alpha_0 + \sum_{i=1}^{n} \alpha_i Z_i^{\lambda_2} + \sum_{i=1}^{n} \beta_i E_i + \sum_{i=1}^{n} \gamma_i M_i,$$

where α, β, and γ are slope parameters and λ_1 and λ_2 are the power transformation parameters to be estimated.

Data Collection and Survey

The hunting lease survey data were collected as a part of a larger survey of ranchland owners conducted in Florida. In the survey, ranchers were asked to provide information on natural attributes of their ranch, along with the details on ranch size, location, distance from the nearest town, cattle population, and other lease management features. Survey respondents were drawn from the Florida Cattlemen's Association (FCA) membership directory. Because the FCA membership information was confidential, the FCA assisted us by selecting a sample of 900 members from the membership directory at random and mailing questionnaires to them. Using the method of Salant and Dillman, a questionnaire and cover letter were mailed to each respondent in the first week of May 2002. Three weeks after the first mailing, a reminder letter was sent with another copy of the questionnaire to those members who had not responded. After the second mailing, we received a total of 421 responses, resulting in a response rate of 47% in the overall sample of our larger survey.

From the larger survey data, we found that only about 10% (41 of 421 ranchers) had hunting leases. Hedonic models, especially using Box-Cox procedure, usually require a relatively larger sample size for the transformation of the parameters (Messonier and Luzar). To supplement the survey data, we selected respondents who held multiple sites with hunting leases. We then obtained details on individual leases and site characteristics of the parcels from their hunting lease records. This yielded a total of 87 observations in our data set, 74 of which had complete information to estimate our hedonic model.[3]

Ranchland Characteristics and Empirical Model

Descriptive analyses of survey responses with hunting leases have indicated that many ranches in Florida are fairly close to towns and consist of several natural attributes that provide various use and nonuse values. The results show that, on average, ranches are within 20 miles of a major town. Ranchers noticed as many as 19 types of birds and/or animals on their ranches, with an average of 6. Approximately 50% of ranchers reported that some form of marsh or wetland, creek/stream, and hardwood trees exist on their ranches. On average, approximately 22% of ranchland is covered with trees and other vegetation, and nearly 10% is occupied by wetlands and streams (Table 1). Approximately 39% ranches have improved pastures and 13% are under native pasture, which is more amenable to hunting leases.

Florida ranchers with hunting leases on their land tend to be relatively affluent, with more ranchland area and natural attributes (Table 1). Although most household characteristics, including age, education level, household size, and sex ratio are similar between the overall survey data and the subsample of ranchers with hunting leases, the latter had more ranching experience and a higher household income.

Hunting, fishing, and horseback riding were reported to be popular recreation activities on ranchlands. Although more than 60% of ranchers in Florida allow some level of recreational use of their ranchlands, permitting hunting leases for fee is a relatively rare activity. Hunting leases are generally short-term in nature, but individual leases can range from 1 to 10 years. On average, 10 people are al-

[3] Combining data collected from different procedures is a common practice in economic valuation (Adamowicz, Louviere, and Williams; Poor et al.). In particular, Poor et al. analyzed implicit values of environmental attributes using data from clinical procedures and surveys.

Table 1. Sample Characteristics and Test of Mean Difference Between Groups

Variable	Without Lease		With Lease		Mean Difference
	Mean	Std. Dev.	Mean	Std. Dev.	
Ranchland Characteristic					
Plot Size (Acres)	1,254.58	6,080.99	5,896.02	12,514.98	4,641.44*
Cattle Herd Size	262.57	867.98	1,195.22	2,166.06	932.00**
Creek/Stream Area (%)	0.39	0.49	0.48	0.50	0.09
Forest Area (%)	13.76	18.43	16.95	16.78	8.09
Wetland Area (%)	6.11	9.60	15.82	14.87	3.98**
Improved Pasture Area (%)	56.66	31.90	39.39	23.48	17.27**
Number Wildlife Seen	4.63	2.82	6.00	2.40	1.36**
Distance (Miles)	16.42	14.94	20.29	15.39	3.87
Respondent Characteristic					
Age (Years)	54.05	14.98	54.43	15.49	0.37
Education (Years)	14.56	2.60	14.78	1.77	0.22
% Male	87.30	33.30	90.24	30.00	0.03
Family Size	2.65	1.26	2.63	1.13	0.02
Ranch Experience (Years)	20.22	24.90	32.00	25.38	11.77**
Household Income ($1,000)	72.66	43.33	94.64	36.51	21.98**

Notes: Sample size without lease is 380, sample size with lease is 41, Std. Dev. is standard deviation.
*, *t*-statistic significant at the 0.05 level; **, *t*-statistic significant at the 0.01 level.

lowed to be on a hunting lease, but the number can be as high as 40. The survey results show that average ranch size under a hunting lease in Florida is approximately 5,896 acres. In response to the question about their willingness to adopt silvopasture, more than half of the ranchers said that they would adopt silvopasture if some financial incentives were provided.

The empirical hedonic model to estimate implicit values is specified using variables defined in Table 2. Hunting lease prices are expected to vary by parcel size (ACREL). Previous research indicated that hunters generally

Table 2. Definition of the Variables Included in the Model

Variable	Expected Sign	Definition
PRICEL	−	Dependent variable: Price per acre paid for hunting leases (2002 U.S. dollars).
Ranchland attribute		
ACREL	±	Parcel size under lease (acres)
SMALLP	+	Parcel size interacted with a dummy variable representing small parcel of 1,000 acre or less (ACREL × SMALLD)
FOREST	+	Ranchland area under trees and vegetation cover (%)
FORWETS	+	Trees and vegetation cover interacted with wetland/stream dummy variable (FOREST × WETSTD), where WETSTD is 1 if the percentage of wetland/stream is greater or equal to the mean (10% of ranchland area)
DISTANCE	—	Distance from nearest city to the ranch (miles)
YEARL	±	Number of years the ranchland is under the hunting lease
PEOPLE	—	Maximum number of people in the hunting lease
DATAS	±	1 if the data were directly obtained from records, 0 if the data were obtained through surveys

preferred larger parcels of land, exceeding 1,000 acres, for hunting leases (Guynn and Busch). The lease price per acre is expected to have a negative relationship with parcel size, suggesting the law of diminishing marginal returns to scale (Brownstone and De Vany; Loomis, Rameker, and Seidl). Furthermore, smaller parcels may have more value because of intensive management or better land use (Colwell and Sirmans; Reynolds and Regalado). To account for hunters' preferences for parcel size, we included an interactive dummy variable by defining parcels that are less than or equal to 1,000 acres as small (SMALLP) and expected a positive sign on this coefficient.

We anticipate that natural attributes of ranchland such as forest, wetland, and streams would positively influence lease prices. As vegetation cover and natural corridors improve the habitat for wildlife, they would increase the success rate in hunting and, thus, hunters' willingness to pay for hunting. The variable representing percentage of trees and vegetation cover (FOREST) is of particular interest in this study because it is a proxy to silvopasture practices. Furthermore, to incorporate the effects of wetlands and streams along with trees and vegetation cover on lease price, we included an interaction variable FORWETS. It is expected that these attributes collectively provide a conducive habitat for wildlife and thus fetch a better lease price.

Access is another important factor that influences hunting demand on ranchlands and thereby the hunting fees. Previous studies have shown that the distance from the nearest town to the hunting site is inversely related to lease prices (Brownstone and De Vany; Colwell and Sirmans; Faux and Perry; Loomis, Rameker, and Seidl; Pope and Stoll; Reynolds and Regalado). Because larger distance indicates less access, we expect that DISTANCE will have a negative effect. Length of contract on hunting leases would provide certainty of access and ensure a stable price. This implies that hunters may pay more to reflect a premium for certainty. However, it can also be argued that ranchers may charge a lower price for their long-term and loyal customers. As such, it is difficult to ascertain *a priori* the impact of YEARL on hunting fees. As the number of users in a particular lease increases, ranchers are likely to charge a higher price. Therefore, we expect that PEOPLE variable, which reflects the number of hunters in a lease, will have a positive impact on lease price. To account for the structural differences in two data sources, we included the DATAS variable in the model.

Table 3. Parameter Estimates and Elasticity of Implicit Values

Variable	Coefficient	Std. Err.	Elasticity
ACREL	−0.4916**	0.2045	−0.0287
SMALLP	0.0004**	0.0002	0.0300
FOREST	0.0049*	0.0029	0.1318
FORWETS	−0.0004**	0.0001	−0.1473
DISTANCE	0.0060**	0.0027	0.2039
YEARL	0.0527**	0.0241	0.1236
PEOPLE	0.0027	0.0064	0.0381
DATAS	0.2165	0.1415	0.0746
ONE	2.5853**	0.5398	—
λ_1	−0.2665**	0.0693	—
Σ^2	0.0197**	0.0028	—
N	74	—	—

Notes: The parameters were estimated using Limdep Version 7.0 (Greene).
*, significant at the 0.10 level; **, significant at the 0.05 level.

Model Results and Discussion

Box-Cox transformations of λ_1 and λ_2 indicated that a double-log model is preferable over other functional forms.[4] The results discussed here are derived from a model wherein the hunting lease price per acre and parcel size are in logarithmic form (Table 3).

Overall, the model results are consistent with the economic theory and *a priori* expectations. The coefficients on seven of nine variables, including a constant term, are significant at $p < 0.1$, and six variables are significant at $p < 0.05$. The coefficient on par-

[4] The double-log model outperformed other functional forms, so we discuss this model in detail. The standard errors of the coefficients are corrected for heteroskedasticity. The results using other functional specifications are available on request.

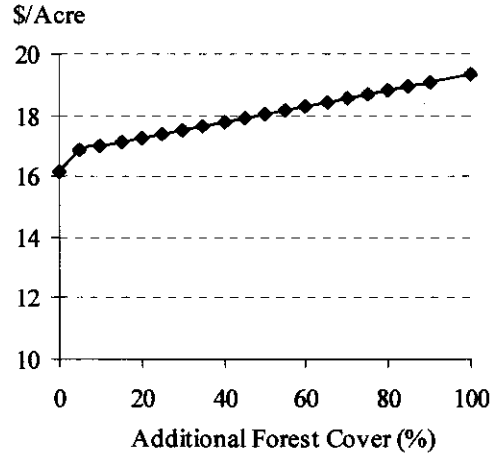

Figure 1. Hunting Revenue Due to Incremental Forest Cover in Ranchlands

cel size is significant at $p < 0.05$, with a negative sign. This result is consistent with our *a priori* expectation in that larger parcels will face diminishing returns to scale. The result is further validated by the interactive dummy variable SMALLP in the model. The coefficient on SMALLP is positive, and the variable is significant at $p < 0.05$, suggesting an inverse relationship between lease price and parcel size.

The variable FOREST, which represents percentage of trees or vegetation cover on ranchlands, is positive and significant at $p < 0.1$. The agroforestry literature often claims that silvopasture provides various environmental benefits, including a conducive habitat for wildlife (Clason and Sharrow). Our results provide evidence to support this argument and suggest that silvopasture will increase hunting revenues. A functional relationship between the lease price per acre and trees and vegetation cover was also assessed (Figure 1). The estimated value of lease price at the means of explanatory variables was calculated at $16.15 per acre. The marginal contribution of an additional percentage of tree and vegetation cover on lease price is $0.03, and doubling the current average percentage cover (21.85%) will increase lease price to $19.35, an increase of nearly 20%. However, it is likely that increasing vegetation cover on ranchlands would reduce the cattle density. Therefore, ranchers must be cautious when increasing the vegetation cover to raise overall income from hunting revenues.

To the extent that hunting is a complementary activity to cattle ranching, returns from hunting leases provide strong incentives for ranchers to keep their land under ranching. According to a land survey in May 2002, ranchlands in Florida were valued between $1,165 and $2,681 per acre (Reynolds). Additional net revenues from hunting leases will provide a boost to ranchers' profitability and land values. When vegetation cover interacts with wetlands and streams (FORWETS), the impact is negative and statistically significant. This is somewhat an unexpected result, because the natural attributes in general are anticipated to have a positive effect on wildlife habitat and, thus, higher lease prices. However, there is no reason to rule out a negative relationship between these variables, suggesting an adverse impact of wetlands and streams by reducing the area available for hunting and limiting access to the areas. Loomis, Rameker, and Seidl also found similar results, suggesting a low opportunity cost of wetlands to landowners. Obviously, when an attribute is perceived positively by some people and negatively by others, the overall impact will be uncertain. For example, 23% of visitors reported that they would increase visitation because of ranchland open space in Steamboat Springs, Colorado, whereas 25% of visitors expressed that they would decrease visitation because of ranchland open space (Rosenberger and Loomis). The overall value of ranchland open space was minimal.

The coefficient on the length of contract (YEARL) is positive and significant, suggesting that a longer lease would fetch a higher price per acre. As was explained earlier, hunters would pay more to ensure certainty in their hunting opportunities and a stable price for an extended period. Because hunting leases are relatively new in Florida, reduction of uncertainty may be a critical factor for recreational hunters. The DISTANCE variable has a positive effect on lease price and is significant—a result that is consistent with the results of Messonier and Luzar. This is an unexpected

result, given the fact that greater distance to the site from nearby towns generally implies less access and thus lower price per acre. However, longer distance also reflects remoteness, and hunters may prefer to travel longer distances to avoid congestion, enjoy rural settings, and realize greater success in hunting. The coefficient on DATAS is insignificant, suggesting no significant difference in the two data sets. As expected, the coefficient on PEOPLE is positive, but it is not statistically significant. The proportionate change in lease price per acre in response to ranchland attributes is expressed in terms of elasticity of the coefficients (see Table 2). For example, a percentage increase in parcel size under lease would decrease lease price per acre by 0.0287%, and doubling the mean parcel size (5,623.49 acres) would decrease lease price per acre by 2.87%, i.e., approximately $0.46.

In sum, the results suggest that smaller ranchlands with vegetation cover and that are farther from urban centers provide greater hunting revenues. Furthermore, longer-term leasing is shown to fetch a greater lease price.

Conclusion

Ranching is an important economic activity in Florida. However, in the face of increasing population growth and associated urban development, many ranchlands might soon disappear if profitability from ranching is not ensured or improved. Recreational hunting is an attractive additional economic opportunity that, when capitalized on by ranchers, can supplement their income from cattle. Because the demand for recreational hunting largely depends on various attributes of the sites, it is important to manage these attributes effectively to realize greater lease price. In this study we estimated the marginal impact of a variety of ranchland attributes on lease prices using a hedonic price model. One of the results that will have important implications for ranchland management is the effect of trees and vegetation cover, an integral part of silvopasture practices, on hunting lease prices. We found a positive impact of trees and vegetation on lease price per acre. However, the results indicate that lease prices may not increase proportionately with trees and vegetation cover. This suggests that it is important to manage vegetation to increase hunting revenues, but ranchers must be cautious to avoid displacing too many cattle while maintaining desired levels of vegetation cover.

Most ranchlands in Florida have the potential to attract recreational hunters. However, only a few ranchers are currently capitalizing on this opportunity. Our study indicates that a typical rancher operating a hunting business receives $16.15 per acre per year from hunting leases. With more than 6 million acres, Florida's ranchlands have the potential of generating additional revenue of more than $100 million. Furthermore, if expenditure on transportation, lodging, food, and other expenses relating to hunting is considered, its economic impact would be even higher. Silvopasture can be a desirable land-use option from the perspectives of conserving rural lands, improving ranchers' livelihoods, generating environmental benefits, and improving the economy.

Farm programs in the United States, such as the Wildlife Habitat Incentive Program (WHIP) reflect public support for the creation of high quality wildlife habitats of national, state, tribal, or local significance on private farms and ranches (United States Department of Agriculture). Through this program, the Natural Resources Conservation Service provides technical and financial assistance to landowners to preserve upland, wetland, riparian, and aquatic habitat areas. In 2003, Florida was allotted $377,000 under WHIP for which ranchers can have access if silvopasture is considered to be qualifying land use.

Our estimate of ranchland hunting value falls within the range of an annual market rental rate of $8.30–$25.00, showing a realistic expectation of ranchers to capture additional rent on natural attributes of their ranchlands. However, caution must be taken when using our aggregate estimates for policy purposes, because market demand and supply for hunting leases will constantly adjust prices, leading to different levels of land allocation for silvopasture. Furthermore, our hedonic

model estimates do not directly account for potential substitution effects of hunting in public lands, such as national forests and state lands. With relatively greater hunting success, security, and privacy, recreational hunting on private ranchlands can be considered a niche market where substitution effects are minimal.

Hunting leases on private ranchlands is a relatively new enterprise in Florida. Ranchers with hunting leases represent only approximately 10% of overall sample; thus, any prediction on hunting leases would be sensitive to some unknown factors that influence the demand and supply of hunting leases. For many ranchers, the knowledge, expertise, and familiarity with leases, prices, rights and responsibilities, and liability or indemnity associated with hunting leases may be very limited. Although organized clubs and corporate groups are providing valuable information to hunters and landowners, government intervention in the form of technical assistance, legal advice, outreach, and extension activities would help overcome many of these constraints.

[Received July 2003; Accepted April 2004.]

References

Adamowicz, W., J. Louviere, and M. Williams. "Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities." *Journal of Environmental Economics and Management* 24(1994):271–92.

Alavalapati, J.R.R., and P.K.R. Nair. "Socioeconomic and Institutional Perspectives of Agroforestry." *World Forests, Society and Environment: Markets and Policies.* M. Palo and J. Uusivuori, eds., pp. 52–62. Dordrecht, The Netherlands: Kluwer Academic Publishers, 2001.

Baen, J.S. "The Growing Importance and Value Implications of Recreational Hunting Leases to Agricultural Land Investors." *Journal of Real Estate Research* 14(1997):399–413.

Bastian, C.T., D.M. McLeod, M.J. Germino, W.A. Reiners, and B.J. Blasko. "Environmental Amenities and Agricultural Land Values: A Hedonic Model Using Geographic Information Systems Data." *Ecological Economics* 40(2002):337–49.

Benson, D.E. "Wildlife and Recreation Management on Private Lands in the United States." *Wildlife Society Bulletin* 29(2001):359–71.

Brownstone, D., and A. De Vany. "Zoning, Returns to Scale, and the Value of Undeveloped Land." *The Review of Economics and Statistics* 73(1991):699–704.

Clason, T.R., and S.H. Sharrow. "Silvopasture Practices." *North American Agroforestry: An Integrated Science and Practice.* H.E. Garrett, W.J. Rietveld, and R.F. Fisher, eds., pp. 119–48. Madison, WI: American Society of Agronomy, Inc., 2002.

Colwell, P.F., and C.F. Sirmans. "Area, Time, Centrality and the Value of Urban Land." *Land Economics* 54(1978):514–9.

Cordell, H.K., B.L. McDonald, R.J. Teasley, J.C. Bergstrom, J. Martin, J. Bason, and V.R. Leeworthy. "Outdoor Recreation Participation Trends." *Outdoor Recreation in American Life: A National Assessment of Demand and Supply Trend.* H.K. Cordell, C.J. Betz, J.M. Bowker, D.B.K. English, S.H. Mou, J.C. Bergstrom, R.J. Teasley, M.A. Tarrant, and J.B. Loomis, eds. Champaign, IL: Sagamore Publishing, 1999.

Faux, J., and G.M. Perry. "Estimating Irrigation Water Value Using Hedonic Price Analysis: A Case Study in Malheur County, Oregon." *Land Economics* 75(1999):440–52.

Florida Agricultural Statistics Service. *Beef Cattle and Calf Inventory by County: Livestock, Dairy, and Poultry Summary.* Tallahassee: Florida Agricultural Statistics Service, 2002.

Florida Cattlemen's Association. *Water Quality Best Management Practices for Cow/Calf Operations in Florida.* Kissimmee: Florida Cattlemen's Association, 1999.

Freeman, A.M., III. *The Measurement of Environmental and Resource Values: Theory and Methods.* 2nd ed. Washington, DC: Resources for the Future, 2003.

Greene, W.H. *Limdep Version 7.0.* Plainview, NY: Econometric Software, Inc., 2002.

Guynn, D.C., and F.A. Busch. "Hunting Leases for Income and Access Control." *Forest Farmer* 46(1987):60–62.

Johnson, R. "Supplemental Sources of Income for Southern Timberland Owners." *Journal of Forestry* 93(1995):22–24.

Jones, W.D., I.A. Munn, S.C. Grado, and J.C. Jones. "Fee Hunting: An Income Source for Mississippi's Non-Industrial, Private Landowners." Bulletin FO164. Mississippi State, MS: Forest and Wildlife Research Center, Mississippi State University, 2001.

Kurtz, W.B. "Economics and Policy of Agrofor-

estry." *North American Agroforestry: An Integrated Science and Practice.* H.E. Garrett, W.J. Rietveld, and R.F. Fisher, eds., pp. 321–60. Madison, WI: American Society of Agronomy, Inc., 2000.

Lansford, N.H., Jr., and L.L. Jones. "Marginal Price of Lake Recreation and Aesthetics: A Hedonic Approach." *Journal of Agricultural and Applied Economics* 27(1995):212–23.

Livengood, K.R. "Value of Big Game from Markets for Hunting Leases: The Hedonic Approach." *Land Economics* 59(1983):287–91.

Loomis, J.B., V. Rameker, and A. Seidl. "A Hedonic Model of Public Market Transactions for Open Space Protection." *Journal of Environmental Planning and Management* 47,1(2004): 83–96.

Messonier, M.L., and E.J. Luzar. "A Hedonic Analysis of Private Hunting Land Attributes Using an Alternative Functional Form." *Southern Journal of Agricultural Economics* 22,2(1990): 129–35.

Milon, J.W., J. Gressel, and D. Mulkey. "Hedonic Amenity Valuation and Functional Form Specification." *Land Economics* 60(1984):378–87.

Morrison, J.L., and S.R. Humphrey. "Conservation Value of Private Lands for Crested Caracaras in Florida." *Conservation Biology* 15(2001):675–84.

Mullin, J.M. "Upland Gamebird Preserves: The Opportunity for an Alternative Enterprise." *Forest Farmers* 53(1994):9–11.

Poor, P.J., K.J. Boyle, L.O. Taylor, and R. Bouchard. "Objective Versus Subjective Measures of Water Clarity in Hedonic Property Value Models." *Land Economics* 77(2001):482–93.

Pope, C.A., and J.R. Stoll. "The Market Value of Ingress Rights for White-tailed Deer Hunting in Texas." *Southern Journal of Agricultural Economics* 17,1(1985):177–82.

Reynolds, J.E. "Agricultural Land Values Increase as Citrus Land Values Decrease: 2002 Survey Results." *Florida Food and Resource Economics* No. 150. Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 2002.

Reynolds, J.E., and A. Regalado. "The Effects of Wetlands and Other Factors on Rural Land Values." *Appraisal Journal* 70(2000):182–91.

Rosen, S. "Hedonic Prices and Implicit Markets: Product Differentiation in Perfect Competition." *Journal of Political Economy* 82(1974): 34–55.

Rosenberger, R.S., and J.B. Loomis. "The Value of Ranch Open Space to Tourists: Combined Observed and Contingent Behavior Data." *Growth and Change* 30(1999):366–83.

Salant, P., and D. Dillman. *How to Conduct Your Own Survey.* New York: John Wiley and Sons, Inc., 1994.

Stribling, H.L. "Hunting Leases." *Forest Farmer* 53(1994):6–8.

Swisher, M.E., J. Mullahey, W. DeBusk, M. Main, A.J. Shriar, G.W. Tanner, J. Selph, P. Hogue, and P. Bohlen. *The Ecological Economics of Florida's Ranches.* Gainesville, FL: University of Florida Extension, 2000.

Thurow, A.P., J.R. Conner, T.L. Thurow, and M.D. Garriga. "A Preliminary Analysis of Texas Ranchers' Willingness to Participate in a Brush Control Cost-sharing Program to Improve Offsite Water Yield." *Ecological Economics* 37(2001):139–52.

United States Department of Agriculture, Natural Resources Conservation Service. "Farm Bill 2002: Wildlife Habitat Incentives Program Fact Sheet." Washington, D.C.: United States Department of Agriculture, Natural Resources Conservation Service, 2003.

Wade, M.A., T. Minton, and L. Delargy. "Pasture Improvement Practices Utilized by Florida Cattlemen." *Florida Scientist* 64(2001):4–5.

Willig, R.D. "Incremental Consumer's Surplus and Hedonic Price Adjustment." *Journal of Economic Theory* 17(1978):227–53.