
Afforestation Motivations of Private Landowners: An Examination of Hardwood Tree Plantings in Indiana

Amy L. Ross-Davis, Shorna R. Broussard, Douglass F. Jacobs, and Anthony S. Davis
Department of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907

ABSTRACT: *While a number of studies have investigated the objectives and characteristics of nonindustrial private forestland (NIPF) owners as they relate to afforestation and reforestation decisions, very few studies have addressed these among NIPF owners in the Central Hardwood Forest Region of the United States, and even fewer have linked these to plantation establishment success. This article reports on such an examination in Indiana. Landowners were found to value their land for the privacy it provides, as a place of residence, and as a legacy for future generations. They afforested primarily to provide for future generations, to supply food and habitat for wildlife, and to conserve the natural environment. Seedling survival was lowest on sites owned by individuals who did not value their land as a legacy for future generations. Many NIPF owners are engaging in requisite behaviors to ensure plantation establishment success. The results of this study are discussed in terms of their importance as indicators of the influence of cost-share programs and the insight they provide into potential target areas for future programs. North. J. Appl. For. 22(3):149–153.*

Key Words: Nonindustrial private forest owners, land ownership characteristics, afforestation motivations, plantation establishment success.

Approximately 150,000 nonindustrial private forest (NIPF) landowners control 85% of the 1.8 million ha of forest in Indiana (Tormoehlen et al. 2000), 97% of which is comprised of hardwood species (Miles 2001). With conservation pressures placed on public forests, NIPF lands are increasingly relied on to provide larger proportions of the national timber supply as well as recreational, aesthetic, water quality, and wildlife benefits (see Knight 1999). A number of federal (e.g., USDA Forest Service, Farm Service Agency, Natural Resources Conservation Service (NRCS), US Fish and Wildlife Service), state (e.g., Division of Forestry, Division of Fish and Wildlife, Cooperative Extension Service), and local (e.g., Soil and Water Conser-

vation Districts, Indiana League of Resource Conservation and Development Councils) agencies have implemented programs to assist NIPF owners with forest management through education, expertise, and financial assistance (MacGowan et al. 2001). For example, the assessed value of land is reduced to \$2.50 per ha and technical aid is provided by the Indiana Department of Natural Resources (DNR) to NIPF owners enrolled in Indiana's Classified Forests program; up to 75% of the initial cost of tree-planting, timber stand improvement, or site preparation for natural regeneration may be supplied by the federal government under cost-share arrangements (Nagubadi et al. 1996). In Indiana, landowners may also qualify for a 10% tax credit and deduction of the reforestation expense over an 84-month period if they choose to reforest land for timber production with the ultimate goal of commercial timber harvest (Hoover 2002). This benefit not only pertains to costs associated with artificial regeneration, but also to expenses related to protection of natural regeneration.

There has been some debate as to whether financial incentives are effective means of encouraging NIPF owners to plant trees. Zhang and Flick (2001) concluded that while reforestation investments are influenced negatively by environmental regulations, there is a positive relationship between reforestation and the availability of public financial

NOTE: Amy Ross-Davis can be reached at (765) 494-9597; arossdav@purdue.edu. Financial support for this project was provided by the Indiana Department of Natural Resources (Indiana Forest Stewardship Challenge Grant) and Purdue University. Dan Ernst, Indiana Department of Natural Resources, Division of Forestry, and Ron Overton, Nursery and Tree Improvement Specialist, USDA Forest Service, contributed considerably to the overall design of the project. Jim Wichman and the staff of Indiana DNR Division of Forestry Vallonia Nursery kindly provided state nursery orders. We also extend our thanks to the many landowners throughout Indiana for their willingness to allow us to sample their plantations and for their enthusiasm for this project. Copyright © 2005 by the Society of American Foresters.

assistance programs. For example, when southern NIPF owners were familiar with the availability of either tax incentives or cost-share programs, there was a 19% increase in the likelihood of reforestation, rising to 38% when familiar with both tax incentives and cost-share programs (Royer and Moulton 1987). Alternatively, Kluender et al. (1999) concluded that NIPF owners would plant trees regardless of assistance payments. Some have argued that increased access to information, not subsidies, would be a better means of increasing reforestation efforts (Boyd 1984).

Much research has been conducted, particularly in the southern United States, to ascertain the underlying motivations for planting trees on NIPF lands. Landowners interviewed in the southern United States mainly reforested because they felt obligated to keep the land productive (Royer and Kaiser 1983). In that same study, the authors discovered that nonreforesting NIPF owners claimed the site would regenerate naturally and that costs associated with reforestation were prohibitive, despite the availability of cost-share programs. Reforesting landowners are also more inclined to attach a high level of importance to timber management than landowners who do not reforest (Doolittle and Straka 1987). Nonindustrial tree-planting is further influenced by availability of federal cost sharing (Kline et al. 2002) and demographic characteristics (Gunter et al. 2001). Specifically, NIPF owners who reforested their land tended to have large ownerships, high income levels, high levels of education, and work in professional or business occupations relative to NIPF owners who choose not to reforest. With regard to NIPF owners' use of technical assistance, those who had a management plan and owned large tracts of land (>40.5 ha) were more likely to use a professional forester (i.e., a consulting or industry forester) for reforestation efforts than landowners who did not have a management plan and owned small tracts of land (<40.5 ha) (Zhang and Mehmood 2001).

It is clear that NIPF owners have a diversity of attitudes and manage their land for a variety of economic and ecological reasons—a trend that persists in the Pacific Northwest (Blatner et al. 1997), the southern United States (Greene and Blatner 1986, Hodge and Southard 1992, Bliss et al. 1997, Moffat et al. 1998, Kluender and Walkingstick 2000), the Central Hardwood Forest Region (Trokey and Kurtz 1982; Marty et al. 1988, Bliss and Martin 1989, Hoover et al. 1997, Erickson et al. 2002), and the eastern United States (Bourke and Luloff 1994, Jones et al. 1995). Previous research in Indiana has shown that NIPF owners are stewardship oriented and do not own forestland solely for timber production (Hoover et al. 1997). Their interests relate to noncommercial values such as erosion control, recreation, and provision of food and habitat for wildlife. In Missouri, Kurtz and Lewis (1981) identified four typologies of landowners (i.e., timber agriculturalist, timber conservationist, forest environmentalist, and range pragmatist) based on their motivations and objectives for land management, but reported that while all landowners surveyed had timber production as an objective, they appreciated wildlife and

nontangible elements of forest ownership. Michigan landowners claimed that aesthetic appreciation was the strongest motivator for retaining woodlots, followed by protecting the environment, with economic motivation significantly less important (Erickson et al. 2002). External incentives, namely income production opportunities, technical assistance, and forest tax incentive programs, primarily influenced the timing and extent of management activities examined in Wisconsin (Bliss and Martin 1989).

While many studies have characterized NIPF owners throughout the Central Hardwood Forest Region, studies focusing specifically on the objectives and characteristics of NIPF owners' afforestation and reforestation decisions have mainly been isolated to the southern United States. Few studies have specifically addressed the motivations for planting trees on private land in the Central Hardwood Forest Region of the United States, and even fewer have addressed how these ownership characteristics, values, and motivations translate into plantation establishment success. We define plantation establishment success as seedling survival within the first 5 years following planting, when seedlings are most susceptible to mortality resulting from browse and competition with surrounding vegetation. Significant funds are allocated each year to assistance programs designed specifically to encourage NIPF owners to plant trees. Many district and consulting foresters are looked to for information with regard to establishing plantations on NIPF land. Thus, it is important for policy-makers and practicing foresters to understand the types of landowners who plant trees and their motivations for doing so. This knowledge will help DNR personnel, among others, to target those motivations that lead to successful plantation establishment on NIPF land. Furthermore, quantifying the actual establishment success of these plantations will help policy-makers gain a better assessment of program effectiveness. The objectives of this research were to: (1) examine ownership characteristics and values of landowners in Indiana who had planted trees between 1997 and 2001; (2) examine their motivations for planting trees; and (3) relate these ownership characteristics, values, and motivations to seedling survival during the critical establishment phase.

Methods

We sampled Indiana state-operated bareroot nursery sales records for 1997 through 2001. In 2001, roughly 5.5 million hardwood seedlings were grown in nurseries throughout Indiana, with approximately 85% of this stock grown in state-operated nurseries (USDA Forest Service 2002). All nursery sales that consisted of at least 300 seedlings of one or more of the three most abundantly sold species [i.e., black walnut (*Juglans nigra* L.), yellow-poplar (*Liriodendron tulipifera* L.), and northern red oak (*Quercus rubra* L.)] were reviewed. More than 2000 nursery orders met these criteria, from which 200 orders were randomly selected for survey (40 from each age class). Not all of the 200 selected landowners could be contacted due to a variety of circumstances (e.g., change of address, death). Of the 151

individuals contacted, 92 completed the afforestation interview (61% response rate). Each landowner provided information on site silvicultural history (Jacobs et al. 2004), landownership characteristics, and motivations for planting trees.

Given that five respondents were either unwilling to allow collection of field data or had lost their plantation to fire, field data were collected from 87 of the sites (Table 1; Figure 1) from May through Aug. 2002. Plantations were sampled using 0.04-ha plots (20 m × 20 m) established randomly throughout each site. The number of plots per site was determined based on plantation area: 10% of the total area was sampled for plantations <2.4 ha, 2–10% of the total area (6–0.04-ha plots) was sampled for plantations between 2.4 and 12 ha, and 2% of the total area was sampled for plantations >12 ha. Percent survival was calculated within each plot.

Spearman rank correlations were used to determine whether percent survival of planted trees correlated with plantation size. Kruskal-Wallis tests were used to compare percent survival of planted trees between sites owned by landowners that had or had not: (1) used a cost-share program; (2) had a written management plan; (3) subdivided or had parcels of their land sold for development; and (4) planted trees previously. Analyses of variance (ANOVA) followed by Tukey's posthoc test were used to identify significant differences at $\alpha = 0.05$ in seedling survival among sites owned by landowners with differing afforestation motivations and ownership characteristics. All data were analyzed using SPSS version 10.1 for Windows (SPSS Inc. 2000).

Results

Ownership Characteristics

The majority of respondents either had retired from their respective profession (28%) or currently worked in agriculture (21%). Of all respondents, 89% were male. For almost two thirds of the respondents (64%), this was the first time they had planted hardwood trees. The average planting size was 6.78 ± 0.62 (SEM) ha, with the majority of sites less than 2.5 ha. Almost half the respondents (45%) own land that is at least 50% forested. Only 14% of those surveyed own land that is less than 10% forested. Of the various ownerships, a forest management plan or forest stewardship plan had been prepared for 51% of respondents. Approximately 68% of plantations were established on land that had previously been in crops, while 15% were established on pastures. The remaining 17% of plantations were established on riparian buffers (6%) or a combination of crop fields, pasture, and/or riparian buffers (11%).

Table 1. Number of plantations sampled per age class.

Plantation age (years)	Number of sampled plantations
1	25
2	15
3	15
4	17
5	15

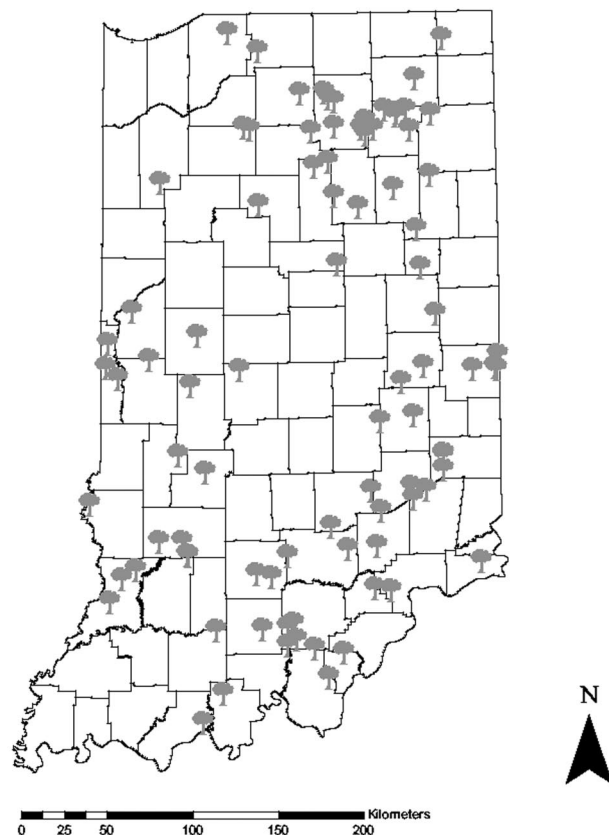


Figure 1. Distribution of 87 sample sites throughout Indiana.

Ownership Values

Generally, NIPF owners in Indiana value their land for the privacy associated with rural life (70% of respondents associated high importance with this value), as a place of residence (70%), as a legacy for future generations (64%), and for land preservation (62%) (Figure 2). Very few landowners claim to value their land for future commercial development or subdivision: 84% of respondents stated this value was not at all important to them. Correspondingly, only 16% of respondents claim to have ever subdivided or sold for development any of their land in Indiana.

Afforestation Motivations

The majority of respondents strongly agreed that providing for future generations (72%), providing habitat and food for wildlife (59%), and conserving the natural environment (54%) motivated them to plant trees (Figure 3). While 79% agreed that their land should be in timber production, only 26% claimed that income from timber production was an important value associated with land ownership. Earlier work indicated that 22% of NIPF owners claimed to have participated in an assistance program (Hoover et al. 1997). This current study focused on an actively managing subgroup of NIPF owners—those who plant trees. Of this subgroup of NIPF owners, 84% received a government cost share, 64% of whom used the Conservation Reserve Program (CRP). Correspondingly, 77% agreed that the availability of such programs motivated them to afforest their land. Only 27% of respondents agreed that availability of tax credits and tax deductions motivated them to plant trees.

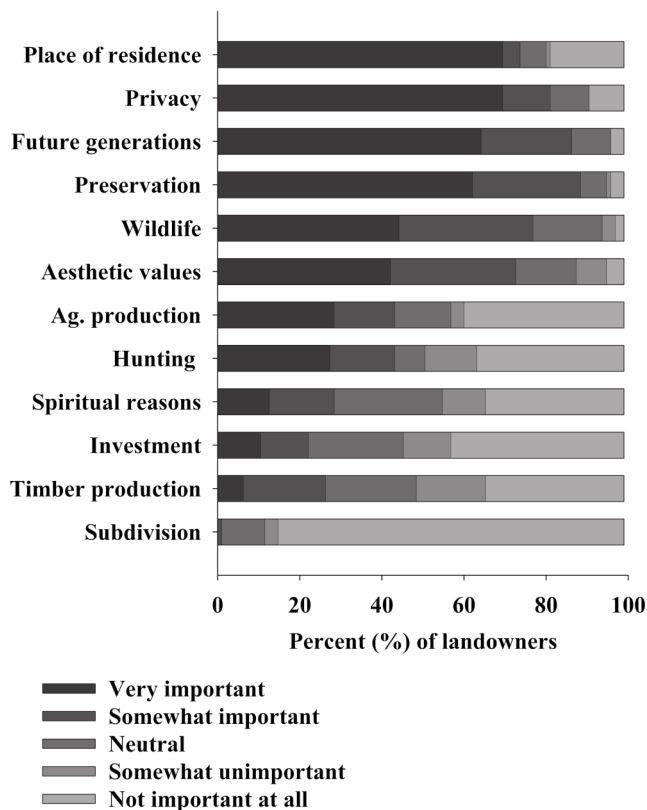


Figure 2. Level of importance assigned to each of 12 values associated with land ownership by respondents.

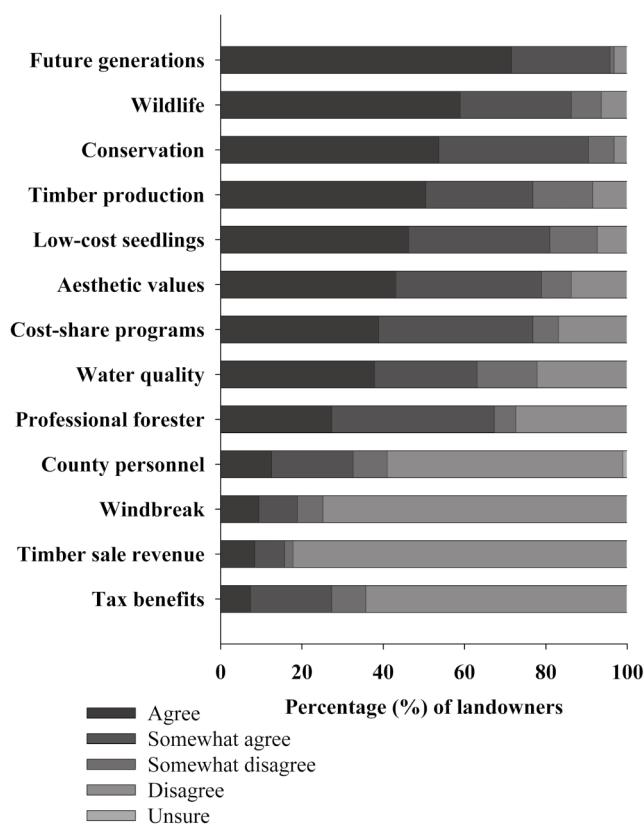


Figure 3. Level of agreement assigned to each of 13 possible motivating reasons for afforestation.

Seedling Survival

Seedling survival was not correlated with plantation size ($r = 0.09$; $P = 0.938$). There were no significant differences in seedling survival between sites for which the landowner had or had not: (1) used a cost-share program ($P = 0.578$), (2) used a management plan ($P = 0.338$); (3) subdivided or had parcels of their land sold for development ($P = 0.421$); or (4) previously planted hardwood trees ($P = 0.284$). Of all afforestation motivations and ownership values ranked by respondents, seedling survival was lowest on sites owned by landowners who did not value their land as a legacy for future generations ($P = 0.031$). All other comparisons yielded insignificant statistics.

Discussion

By specifically targeting afforesting NIPF owners to identify reasons for planting hardwood trees and values associated with land ownership, these results build on existing literature, which focused primarily on comparing attributes between reforesting and nonreforesting landowners (Royer and Kaiser 1983, Royer and Moulton 1987, Doolittle and Straka 1987). Our results are congruent with previous work establishing that NIPF owners have a diversity of attitudes and manage their land for a variety of economic and ecological reasons. However, unlike previous studies, which concluded that landowners in the southern United States mainly reforest to keep the land productive and attach a high level of importance to timber management (Royer and Kaiser 1983, Doolittle and Straka 1987), the majority of afforesting NIPF owners in Indiana are planting trees primarily for conservation-related reasons (i.e., to provide for future generations, supply food and habitat for wildlife, and to conserve the natural environment). The potential regional variation with regard to landowners' motives for tree planting may be attributable to regional differences in harvest rates, reforestation costs, and federal cost sharing (Zhang and Mehmood 2001, Kline et al. 2002) or to overall demographic differences (Gunter et al. 2001).

One of the most appreciable contributions of this study is recognition of the quality of forest management activities undertaken by afforesting landowners. Landowners establishing hardwood plantations in Indiana are planning on a longer time horizon than most private landowners nationwide, as evidenced by the percentage of landowners in this study who have a written management plan for their forestland, which is ten times the national average (Birch 1996), and who are actively engaging in the silvicultural practices that have been demonstrated to ensure successful plantation establishment. Afforesting NIPF owners in Indiana are engaging in many of the requisite behaviors to ensure successful plantation establishment. Landowners are using a professional forester (75%) with a mechanical tree planter (87%) to plant seedlings, and applying herbicide subsequent to planting (87%). These practices have been demonstrated to significantly improve plantation success (Jacobs et al. in press). However, only 38% of landowners are chemically preparing their sites prior to tree planting, a practice that has also been demonstrated to significantly increase survival of

planted seedlings during the establishment phase (Jacobs et al. in press). With regard to the motivations behind tree-planting, engaging in management planning for future generations seems to have a direct benefit to the forest resource, as plantation establishment success was highest on sites owned by landowners who valued their land as a legacy for future generations.

Implications

The results of this study are important indicators of the influence of cost share programs and also provide insight into potential target areas for future cost share programs. This was the first time that many of the respondents had planted trees (64%), and most were planting trees on former agricultural lands (i.e., cropland and pasture). Native American accounts indicate that just 200 years ago Indiana's landscape was 85% forested. Much of the forest was cleared from the rich soil to make way for agriculture, leaving only 7% of the original forest remaining by 1900. In 1998, forests covered 20% of Indiana's landscape (Tormoehlen et al. 2000). Clearly a shift in landcover is occurring on marginal agricultural lands and federal and state cost-share programs are providing considerable impetus for this. Our results hold promise for the regeneration of hardwood trees on private land and may be used to help direct technical and financial resources toward the silvicultural practices that promote establishment success for hardwood tree plantings, while appealing to the diversity of reasons that landowners plant trees and own land.

Literature Cited

- BIRCH, T.W. 1996. Private forestland owners of the United States, 1994. USDA For. Serv. Res. Bull. NE-134. 293 p.
- BLATNER, K.A., D.M. BAUMGARTNER, AND S. GIBBS. 2000. A 1999 survey of NIPF landowners in Washington State: Objectives and issues. P. 13–16 in Summit 2000: Washington Private Forest Program, J. Agee (ed.). Olympia, WA.
- BLISS, J.C., AND A.J. MARTIN. 1989. Identifying NIPF management motivations with qualitative methods. *For. Sci.* 35(2):601–622.
- BLISS, J.C., S.K. NEPAL, R.T. BROOKS, JR., AND M.D. LARSEN. 1997. In the mainstream: Environmental attitudes of mid-south forest owners. *South. J. Appl. For.* 21(1):37–43.
- BOURKE, L. AND L.E. LULOFF. 1994. Attitudes toward the management of nonindustrial private forest land. *Soc. Nat. Res.* 7(5):445–457.
- BOYD, R. 1984. Government support of non-industrial production: The case of private forests. *South. J. Econ.* 51(3):89–107.
- DOOLITTLE, L., AND T.J. STRAKA. 1987. Regeneration following harvest on non-industrial private pine sites in the south: A diffusion of innovations perspective. *South. J. Appl. For.* 11(1):37–41.
- ERICKSON, D.L., R.L. RYAN, AND R. DEYOUNG. 2002. Woodlots in the rural landscape: Landowner motivations and management attitudes in a Michigan (USA) case study. *Land. Urban Plan.* 58(2–4):101–112.
- GREENE, J.L., AND K.A. BLATNER. 1986. Identifying woodland owner characteristics associated with timber management. *For. Sci.* 32(1):135–146.
- GUNTER, J.E., S.H. BULLARD, M.L. DOOLITTLE, AND K.G. ARANO. 2001. Reforestation of harvested timberlands in Mississippi: Behavior and attitudes of non-industrial private forest landowners. Forest and Wildlife Research Center, Bulletin F0172, Mississippi State University. 25 p.
- HODGE, S.S., AND L. SOUTHARD. 1992. A profile of Virginia NIPF landowners: Results of a 1991 survey. *Virg. For.* 47(4):7–11.
- HOOVER, W.L. 2002. Focus on private forest landowners: Knowing the rules pays off at tax time. *J. For.* 100(1):7.
- HOOVER, W.L., W.L. MILLS, JR., AND S. VASAN. 1997. Nonindustrial private forest landowners in Indiana: Are their objectives and attitudes consistent with ecosystem management? P. 150–155 in Proc. of conf. on integrating social science and ecosystem management: A national challenge, Cordell, H.K. (ed.). USDA South, Res. Stat. Gen. Tech. Rep. 017, Helen, GA.
- JACOBS, D.F., A.L. ROSS-DAVIS, AND A.S. DAVIS. 2004. Establishment success of conservation tree plantations in relation to silvicultural practices in Indiana, USA. *New For.* 28(1):23–36.
- JONES, S. B., A.E. LULOFF, AND J.C. FINLEY. 1995. Another Look at NIPFs: Facing our Myths. *J. For.* 93(9):41–44.
- KLINE, J.D., B.J. BUTLER, AND R.J. ALIG. 2002. Tree planting in the south: What does the future hold? *South. J. Appl. For.* 26(2):99–107.
- KLUENDER, R.A., AND T.L. WALKINGSTICK. 2000. Rethinking how nonindustrial landowners view their lands. *South. J. Appl. For.* 24(3):150–158.
- KLUENDER, R.A., T.L. WALKINGSTICK, AND J.C. PICKETT. 1999. The use of forestry incentives by nonindustrial forest landowner groups: Is it time for a reassessment of where we spend out tax dollars? *Nat. Res. J.* 39(3):799–818.
- KNIGHT, R.L. 1999. Private lands: The neglected geography. *Conservation Biol.* 13(2):223–224.
- KURTZ, W.B., AND B.J. LEWIS. 1981. Decision-making framework for nonindustrial private forest owners: An application in the Missouri Ozarks. *J. For.* 79(5):285–288.
- MACGOWAN, B. J., B. K. MILLER, AND J. R. SEIFERT. 2001. Forestry and wildlife management assistance available to Indiana landowners: Providers, Organizations, and Programs. Purdue University Cooperative Extension Service, Bulletin FNR-87. 16 p.
- MARTY, T.D., W.B. KURTZ, AND J.H. GRAMANN. 1988. PNIF owner attitudes in the Midwest: A case study in Missouri and Wisconsin. *North. J. Appl. For.* 5(3):194–197.
- MILES, P. 2001. Indiana's forest resources in 1999. USDA For. Ser., NC Res. Stn., Res. Note NC-377. 6 p.
- MOFFAT, S.O., F.W. CUBBAGE, A.J. CASCIO, AND R.M. SHEFFIELD. 1998. The future of forest management on NIPF lands in the south: Results of an expert opinion survey. P. 17–24 in Proc. of conf. on Southern Forest Economics Workshop, Abt, K.L., and R.C. Abt (eds.). SRS, Research Triangle Park, NC.
- NAGUBADI, V., K.T. MCNAMARA, W.L. HOOVER, AND W.L. MILLS, JR. 1996. Program participation behavior of nonindustrial forest landowners: A probit analysis. *J. Agr. Appl. Econ.* 28(2):323–336.
- ROYER, J.P., AND R.J. MOULTON. 1987. Reforestation incentives: Tax incentives and cost sharing in the south. *J. For.* 85(8):45–47.
- ROYER, P.R., AND H.F. KAISER. 1983. Reforestation decisions on harvested southern timberlands. *J. For.* 81(10):657–659.
- SPSS, INC. 2000. Statistical package for the social sciences 10.0 for Windows. Prentice-Hall, Englewood Cliffs, NJ.
- TORMOEHLN, B., J. GALLION, AND T.L. SCHMIDT. 2000. Forests of Indiana: A 1998 overview. USDA For. Serv. NA-TP-03-00. 18 p.
- TROKEY, C.B., AND W.B. KURTZ. 1982. Increasing timber management through a better understanding of nonindustrial private forest owner's motivations and objectives. *The Consult.* 27(3):57–59.
- USDA-FS, THE SOUTHERN REGION EXTENSION FORESTRY OFFICE. 2002. www.nmgr.net/nurseries/dirfor.html (accessed Oct. 24, 2002).
- ZHANG, D., AND W.A. FLICK. 2001. Sticks, carrots, and reforestation investment. *Land Econ.* 77(3):443–456.
- ZHANG, D., AND S.R. MEHMOOD. 2001. Predicting non-industrial private forest landowners' choices of a forester for harvesting and tree planting assistance in Alabama. *South. J. Appl. For.* 25(3):101–107.