

Non-operator landowner interest in agroforestry practices in two Missouri watersheds

J. Gordon Arbuckle Jr. · Corinne Valdivia ·
Andrew Raedeke · John Green · J. Sanford Rikoon

Published online: 4 April 2008
© Springer Science+Business Media B.V. 2008

Abstract Land tenure has long been considered a critical factor in determining the adoption and long-term maintenance of agroforestry practices. Empirical evidence from non-US settings has consistently shown that secure land tenure is positively associated with agroforestry adoption. In the US, over 40% of private agricultural land is farmed by someone other than the owner. Given the importance of land tenure in agroforestry decisions in other countries and the magnitude of non-operator landownership in the US, there has been surprisingly little focus on land tenure in the temperate agroforestry literature. Using data from a 1999 survey in Missouri, this study explores factors associated with non-operator landowner

interest in agroforestry. Results suggest that differences in farming orientation are linked to interest in agroforestry. Closer ties to farming, stronger financial motivations for landownership, and higher proportion of land planted to row crops were negatively related to interest in agroforestry among non-operator landowners. Environmental or recreational motivations for landownership and contacts with natural resource professionals were positively associated with interest in agroforestry. These results, consistent with earlier qualitative research suggesting that farm operators who have a strong “conventional farming identity” were less interested in agroforestry, point to a divide between landowners for whom environmental and recreational values play an important role in ownership motivation and those for whom financial considerations take precedence. The findings imply that agroforestry development programs in the US should take non-operator landowners and their farming and ownership orientations into account when designing research and outreach efforts.

J. G. Arbuckle Jr. (✉)
Department of Sociology, Iowa State University,
303C East Hall, Ames, IA 50011, USA
e-mail: arbuckle@iastate.edu

J. S. Rikoon
Department of Rural Sociology, University of Missouri,
Columbia, MO, USA

C. Valdivia
Department of Agricultural Economics, University
of Missouri-Columbia, Columbia, MO, USA

A. Raedeke
Missouri Department of Conservation,
Columbia, MO, USA

J. Green
Delta State University, Cleveland, MS, USA

Keywords Adoption · Land tenure ·
Non-operator landowner

Introduction

Land tenure has long been considered a critical factor in determining the adoption and long-term maintenance of agroforestry practices (Mercer 2004;

Pattanayak et al. 2003). Mercer's (2004) review of agroforestry adoption research from the tropics found that in all studies in which tenure was a significant variable, secure land tenure was positively associated with adoption. Pattanayak et al. (2003) review of agroforestry adoption research also found that landowners are more likely than tenants to adopt agroforestry practices. The interpretation of the consistently positive relationship between secure land tenure and agroforestry adoption is unambiguous: the long-term production horizon of agroforestry practices makes tenure security a virtual precondition to agroforestry adoption.

What role might land tenure play in the agroforestry adoption decisions of US landowners and farm operators? A high proportion of agricultural land in the US is farmed by someone other than the owner. According to United States Department of Agriculture estimates, approximately 2.3 million landlords rented 419 million acres (170 million ha) of agricultural land to farm operators. Of those, 1.4 million private non-operator landowners accounted for about 390 million acres (158 million ha). That acreage represents 42% of the private agricultural land and 94% of the rented land employed in agriculture in the US (National Agricultural Statistics Service 2001, p. 267).

Given the importance of land tenure in agroforestry adoption decisions in other countries and the magnitude of non-operator landownership in the US, there has been surprisingly little focus on land tenure in the temperate agroforestry literature. While land tenure status would likely be a factor in agroforestry adoption decisions in the US as it is in other countries, the lack of empirical agroforestry adoption research in the US limits our ability to draw conclusions. However, we can look to the literature on the adoption of conservation practices for guidance. Factors associated with conservation practice adoption decisions, especially for practices for which benefits accrue over a longer term and/or involve landscape alterations, may be similarly associated with agroforestry adoption decision-making processes.

Numerous studies on the adoption of soil and water conservation practices have focused on land tenure as a determinant of likelihood to adopt. Clearfield and Osgood's (1986) review of adoption studies notes that the relationship between ownership and conservation practice implementation has generally been found to be positive. More recently,

Featherstone and Goodwin (1993) found that investment in conservation practices was inversely related to the proportion of rented land on farms. Soule et al. (2000) disaggregated short-term and medium-term practices to test tenure effects on adoption of conservation practices with longer benefit horizons, such as grassed waterways or terraces. They found that renters were less likely to adopt medium-term practices than were owner-operators, indicating that adoption of medium- or long-term conservation practices was positively associated with land ownership. Fraser's (2004) study of land tenure and soil conservation practices in British Columbia produced results of particular interest to the agroforestry field: while renters tended to plant crops with short-term returns, farm ownership was associated with investment in long-term crops such as perennial fruiting bushes and vines.

Kurtz (2000, p. 349) relates this renter/owner adoption problem to agroforestry: "If an operator is not certain that a payoff from an investment is forthcoming during the period in which a land resource is used, it is not likely that the investment will be made." Decisions concerning adoption of practices that have long production horizons or require alteration of the landscape—to which category agroforestry belongs—would be primarily the landowners' to make. Given that over 40% of agricultural land in the US is rented from non-operator landowners, agroforestry adoption research should focus on the relationship between this group and agroforestry. This research seeks to shed light on this understudied area through exploration of factors associated with non-operator landowner interest in agroforestry practices.

Methods

Study context

The data for this study were gathered in 1999 as part of a larger EPA-funded research project entitled "The Economic and Social Value of Flood Plain Agroforestry to Rural Development Projects." Data were collected from non-operator landowners whose farms were located in the Fox Wyaconda watershed in Northeast Missouri and Scott County in Southeast Missouri. The 700,000 acres (283,290 ha) that

comprise the study areas contain a diverse mix of cropland, pasture, hayland, and forest across both hills and floodplains along the Mississippi River and tributaries.

Variable selection and measurement

The primary objective of this study is to assess the relationship between non-operator landowner interest in agroforestry and factors that have been shown to be related to farm operator and landowner propensity to adopt conservation practices. Based on a review of soil and water conservation practice adoption literature, we hypothesize that variables from four general areas will influence non-operator landowner interest in agroforestry implementation: (1) farming community; (2) ownership motivation/orientation; (3) knowledge of agroforestry; and (4) demographic characteristics.

Independent variables

The farming community

Community variables play a role in landowners' decision-making processes. Raedeke et al. (2003) found that farm operators who had a strong "conventional farmer" identity were skeptical of agroforestry. They suggested that family and rental relations exerted pressures to conform to a "good farming" ideal that views trees and cropland as incompatible. Salamon et al.'s (1997) comparison of "sustainable" and "conventional" farming families led to similar findings. Their study indicated that community expectations and values can be opposed to farming practices that depart from established norms. Raedeke et al. (1998), using length of land ownership (individual or family) and farm experience as proxies for connection to the farming community, found that these factors were negatively associated with interest in conservation program participation.

Several of the farming community variables that we employ measure landowner relationships with their land. Two variables are measures of participation in farming: whether or not the respondent or spouse ever farmed the land, and whether anyone in the family was currently farming the land. These two variables were combined into one binary variable representing family participation in farming their land. Two variables

measuring family landownership continuity were also included: how long the land had been in the family, and likelihood that the land would be passed down to someone in the family. A second set of variables measures the influence that three non-family groups in the farming community—other farmers/landowners, potential renters, and bank/lending institution representatives—have on farm/land management decisions. Because previous studies have found that farming community pressures can be negatively associated with alternative practices, we expect to find a negative relationship between each of the variables described above and interest in agroforestry.

Two variables relate to what have traditionally been termed "change agents" or information sources: extension and natural resource professionals (NRPs). The role of communication sources and communication channels in transmitting information on innovations has been a core focus of adoption research since its inception (Fliegel 1993; Rogers 2003). In terms of influence on conservation practice adoption, however, results have been mixed. Lockert (1990) pointed out that using number of contacts with conservation professionals as an explanatory variable can be problematic. Particularly if contact is voluntary, as it often is, this variable may measure the landowners' willingness to address problems that they have identified on their land rather than the influence of conservation professionals on landowner decision making. This ambiguity notwithstanding, contact with extension or conservation professionals is generally hypothesized to be positively associated with adoption of innovations, whether production- or conservation-oriented.

To assess the relationship between non-operator landowner interest in agroforestry and contact with information sources, we include two variables in the analysis: number of field days or demonstrations about farming or land management attended and number of times the landowner had received advice from a professional such as a "Soil and Water Conservation District (SWCD) technician or an agricultural business person" over the previous 2 years. Both of these variables may pose problems because the nature of the contacts is unknown. The first variable does not tell us what the focus of attended field days was: they could have dealt with anything from pesticide application to conservation buffers. The second variable is equally ambiguous.

While it is reasonable to assume that contact with an SWCD technician would be conservation-related, it is equally reasonable to assume that contact with an “agricultural business person” would be production-oriented. These variables nevertheless are included in the analysis, although hypotheses about direction of influence are not made.

Farming orientation and ownership motivations

A number of studies have examined the relationship between conservation behavior and orientation toward farming or landownership motivation (Nowak and Korsching 1998). Some farmers may be more commercially oriented while others may lean more toward an environmental, or stewardship orientation, and their orientation can affect their interest in adoption of conservation practices. Salamon et al. (1997) found that families that had adopted “sustainable” practices often had strong environmentalist traditions or stewardship perspectives that influenced their adoption decisions. Allen and Bernhardt (1995) observed that farmers who had “worldviews” corresponding to an alternative agricultural paradigm were less likely to use synthetic fertilizers and herbicides and more likely to employ conservation practices such as field windbreaks and rotational grazing. In his study of landowner motivations in Indiana, Koontz (2001) found that landowners who did not rely on their land for a substantial portion of their income were much more likely to cite non-monetary benefits of landownership than owners who did. Commonly cited motivations were aesthetic values and protection of soil and wildlife habitat. These studies suggest that landowners’ attitudes or motivations can have an influence on the type of production or conservation practices that they pursue.

We focus on two dimensions of landownership motivation: environmental/recreational and financial. Two index variables measure the role that these distinct motivation types play in landowner decisions to own land. The environmental/recreational motivation index was constructed by adding the respondents’ ratings of the influence that three environment- or recreation-related motivations have on their owning land: likes being on the land and enjoys its natural beauty; enjoys recreation on land; and enjoys seeing wildlife on the land.¹ The financial motivation index was created by adding respondents’

ratings of the influence that three financial-related reasons have on their owning land: owning farmland provides a good financial shelter; the land is a good investment; and the land provides a good source of income.² It is expected that environmental and recreational motivations for landownership will translate into interest in agroforestry, while financial motivations will be negatively associated with interest in agroforestry.

A third variable that relates to farming orientation is percentage of land planted to row crops. Row crop farming is a hallmark of the commercially oriented farmer. This intensive use of land generally requires greater mechanization and use of purchased inputs such as fertilizers and pesticides than do grazing or forestry. Soule et al. (2000) found that percentage of land in corn and soybeans was negatively associated with landowner adoption of medium-term conservation practices. We expect a similar relationship to interest in agroforestry. We hypothesize that greater involvement in row cropping, even indirectly through income from leasing arrangements, will translate into a stronger “conventional farming” identity and be negatively associated with interest in agroforestry.

Knowledge of agroforestry

Awareness of a practice is of course a precondition to adoption. Beyond awareness, degree of knowledge regarding the application of farming practices, conservation or otherwise, is a necessary (though not sufficient) condition for adoption. Knowledge becomes particularly critical in association with complex and unfamiliar practices due to uncertainty (Pannell 1999).

We include an overall agroforestry knowledge index in our analysis. The index was constructed by summing respondents’ rating of their level of knowledge of the five agroforestry practices under consideration: silvopasture, riparian/streambank plantings, alleycropping, windbreaks, and forest farming.³ Although it is possible that increased knowledge of innovations can lead to non-adoption or dis-adoption of practices, we hypothesize that

¹ $\alpha = 0.715$.

² $\alpha = 0.840$.

³ $\alpha = 0.814$.

degree of knowledge will be positively associated with interest in agroforestry.

Demographic characteristics

Demographic variables such as age, education, and gender have long been examined as potential determinants of landowner propensity to adopt conservation practices (Clearfield and Osgood 1986; Nowak and Korsching 1998; Traore et al. 1998), but empirical results on these variables have been mixed (Lockeretz 1990). Feder and Umali (1993) cite several studies indicating that age is negatively associated with adoption due to the shorter planning horizons of older farmers. Feder and Umali (1993) also point out that education level has been found in numerous studies to have a positive relationship to conservation practice adoption. We expect to find similar relationships between age, education level, and interest in agroforestry.

Dependent variable: interest in agroforestry

The dependent variable, average overall interest in agroforestry practices, was constructed from a set of five questions that respondents answered after examining two images of each practice and reading a corresponding definition.⁴ The definitions given for each practice were: (1) “silvopastoral—*intentionally* planting or managing trees in pastures”; (2) “riparian buffers/streamside plantings—planting trees, shrubs and grasses along streams and waterways”; (3) “alley cropping—crops grown in wide alleys between rows of trees”; (4) “windbreaks—trees planted as barriers against the wind”; and (5) “forest farming—growing crops under the shade of trees.” Using a scale from one (uninterested) to four (very interested), respondents were asked to rate how interested they might be in implementing each of the five agroforestry practices on their land.⁵ An index variable was created by

⁴ For silvopasture agroforestry, a third image was included of cattle grazing in a forested area with the note: “Cows grazing in a forested area without any intentional management of the trees is not considered silvopastoral.” For forest farming, photos of ginseng and mushroom cultivation were accompanied by the note: “Examples of forest farming: growing ginseng and shiitake mushrooms.”

⁵ No information about potential benefits of agroforestry, either environmental or financial, was provided to respondents.

summing the five scales and dividing that number by five.

Data collection

The sampling frame for this study consisted of all non-operator landowners in the Fox Wyaconda watershed and in Scott County. In the Fox Wyaconda watershed, a list of all area farmland owners was provided by the Natural Resources Conservation Service (NRCS). Two-hundred ninety-two non-operator landowners were identified from the larger list. Of these, one-third resided more than 30 miles (48 km) from the watershed. The survey instrument was mailed to the entire sampling frame of 292 landowners. One hundred eleven surveys were completed and returned, for a response rate of 38%. In Scott County, the local Farm Services Agency office provided a list of 696 non-farming landowners. This sample frame was stratified by distance of residence from Scott County (less than/more than 30 miles) in order to match the proportion of absentee to local landowners found in the FWW. A stratified random sample of 150 landowners from within 30 miles of the county line and 77 landowners who lived farther away was drawn. The surveys were mailed to these 227 landowners. One hundred twenty eight surveys were completed and returned for a response rate of 56%. The overall response rate was 46%, resulting in a final sample of 239 non-operator landowners.

Analysis

The data were analyzed using Ordinary Least Squares (OLS) regression. The model regressed overall interest in agroforestry practices on 14 independent variables. A number of the variables included in the model had missing values. When missing values are present throughout observations and variables in a multivariate study, listwise deletion in regression analysis can result in a significant loss of data (Newton and Rudestam 1999). Several strategies may be employed to deal with missing values. When fewer than 15% of observations are missing for a given variable, imputation, or estimation of the missing values, may be used (Newton and Rudestam 1999). For this study, we employed mean substitution to estimate missing values for a number of variables. Although this method reduces the variance associated

with the variables for which it employed, and therefore results in a reduction of statistical power, it is a conservative method that does not bias results unduly (Newton and Rudestam 1999).

Results

Descriptive results

Demographic, farm, and farming characteristics

Landowners in the sample averaged 61 years of age (Table 1). Nearly 40% reported that they were college graduates. They owned, on average, 361 acres (146 ha) of land, at least a portion of which had been in the family for an average of 58 years. The average likelihood that the land would be passed on to someone in the family was 3.9 on a 5-point scale. Taken together, these data indicate a high level of inter-generational land-ownership continuity among the sample landowners.

Given the average length of ownership and apparent intergenerational continuity, the percentage of landowners (or their spouses) who had actually farmed the land in question was surprisingly low, at 41%. Twenty-seven percent of respondents indicated that a family member was currently farming the land. Fifty percent of respondents had either farmed the land or had a family member farming it at the time of the survey. The majority of respondents' land (57%) was reported to be cropland, while 12% was pasture or hayland. Fourteen percent of land was unmanaged timber and 4% was managed timber.

Table 1 Demographic, farming, and farm characteristics variables ($n = 239$)

Age (mean)	61
College graduate (%)	39
Respondent or spouse once farmed their land (%)	41
Family member currently farming land (%)	27
Respondent or spouse farmed or family member farming (%)	50
Proportion of land in crops (%)	57
Proportion of land in pasture/hayfields (%)	12
Proportion of land in managed timber (%)	4
Proportion of land in unmanaged timber (%)	14

In terms of contacts with agricultural or conservation information sources, only 16% of respondents had attended a field day or other similar event in the past 2 years (Table 2). Thirty-two percent had received advice from a professional such as a Soil and Water Conservation District technician or agricultural business person over the same time period. On average, respondents reported that other actors in the field of agriculture had a moderate influence on their decisions. Opinions of potential renters had the most influence, at 2.8 (on a scale from one to five), with opinions of other farmers (2.4) and bankers or other lenders (1.5) following in importance.

Landownership motivation

Motivations behind land ownership were measured on a scale ranging from 3 to 15 (Table 3). The average score on the environmental or recreational index was 9.4. The average financial index score was 8.3.

Agroforestry knowledge and interest

Overall agroforestry knowledge among respondents averaged 1.8 on a 5-point scale on which one corresponded to "very low" and five to "very high" (Table 4). Reported knowledge of windbreaks was highest at 2.37, while knowledge of forest farming

Table 2 Contacts and influence ($n = 239$)

Mean number of farm-related informational events, last 2 years	
Field days or demonstrations	0.40
Advice from professional invited to land	0.91
Attended at least one farm-related info. event, last 2 years	
Percentage who attended field days or demonstrations	16
Percentage who got advice from a professional	32
Influence of other actors on decisions scales (5-point scale)	
Other farmers	2.4
Potential renters	2.8
Bankers/lenders	1.5

Table 3 Landownership motivation indices ($n = 239$)

Mean importance of reasons for landownership ^a	
Environmental or recreational	9.4
Financial	8.3

^a Scale range 3–15

Table 4 Agroforestry practice knowledge and interest ($n = 239$)

	Silvo-pasture	Riparian buffer	Alley cropping	Wind-breaks	Forest farming	Overall
Knowledge of practices (5-point scale)	1.55	1.93	1.64	2.37	1.52	1.79
Interest in practices (4-point scale)	1.68	1.79	1.46	1.82	1.67	1.68

averaged only 1.52. With the exception of wind-breaks, then, results indicated that familiarity with agroforestry among respondents was low overall.

The dependent variable, overall interest in agroforestry for owned land, averaged 1.7 on a scale of four (Table 4). In other words, most respondents reported that they were either uninterested or slightly interested. Seventy percent of respondents scored lower than two on the 4-point scale, about 21% ranged between two and three (slightly-to-moderately interested), and only about 4% scored over three on the overall interest scale.

Among individual practices, interest in windbreaks was highest, averaging 1.82, with 25% of respondents indicating that they were either moderately or very interested in the practice. Interest in riparian buffers followed closely at 1.79, and 27% of respondents were either moderately or very interested in that practice. Alley cropping garnered the lowest level of interest (1.46): only 15% of respondents expressed moderate to keen interest in this practice.

Regression results

The OLS regression results for the model (Table 5) indicate that it is significant ($F = 7.838$, $P < 0.001$) and explains a moderate amount of the variation in overall interest in agroforestry (Adj. $R^2 = 0.287$).

Several significant relationships emerged between the variables pertaining to the farming community and interest in agroforestry. First, participation in farming was negatively associated with interest in agroforestry. That is, respondents who used to farm the land (or whose spouse farmed the land) or who had a family member farming the land, expressed significantly lower levels of interest in agroforestry. This result appears to be in line with Raedeke et al. (2003) findings on the incompatibility between the habitus/field of farming and agroforestry. Perhaps people who have a stronger connection to the actual

farming of their land have particular ideas about how it should be farmed, and agroforestry does not fit that mold. Actual participation in farming seems to be a much more important predictor than land ownership continuity: neither length of family ownership nor likelihood of family inheritance was significantly associated with interest in agroforestry.

Among the variables measuring the importance of other actors' opinions in decision making, only the banker/lender influence variable explained variance in non-operator landowner interest in agroforestry. Respondents who rated the influence of bankers or lenders on their land-use decisions as high also tended to express higher interest in agroforestry. This was an unexpected result, and it is not clear why this relationship was positive. One potential explanation could be that non-operator landowners who cite lender influence on their decision making still carry debt on their land and see agroforestry as a means toward protecting its value. Further discussion of the relationship between ownership motivation and interest in agroforestry is found below.

Of the two information source variables, only the number of times the respondent received advice from a professional was significant. As noted above, there was some question as to how the wording of the question might influence the result. Given the strong positive relationship between this variable and interest in agroforestry, a majority of respondents probably were referring to contacts with natural resource professionals when answering this question. This result—that non-operator landowners who have had more contacts with natural resource professionals (NRPs) are more open to the idea of agroforestry—makes sense. Landowners who have multiple contacts with NRPs are generally those who are seeking assistance on conservation issues. This indicates that agroforestry practices appeal to landowners who are already involved in or considering environmental improvement efforts.

Table 5 OLS regression of interest in agroforestry practices on selected independent variables

	<i>b</i>	β	SE	Sig.
Constant	1.361	−0.154	0.295	0.000
Farming participation (No = 0)	−0.219	0.014	0.080	0.007
Years land in family	0.000	−0.052	0.001	0.813
Likelihood leave to family	−0.026	−0.126	0.030	0.381
Percent of land in crops	−0.253	−0.072	0.127	0.047
Influence of other farmers' opinions	−0.045	0.049	0.039	0.251
Influence of potential renters' opinions	0.029	0.124	0.038	0.452
Influence of bank/lender requirements	0.097	−0.058	0.048	0.046
Number of field days or demonstrations	−0.035	0.217	0.036	0.336
Number times advice from professional	0.080	0.294	0.022	0.000
Env/rec. reasons for owning index	0.055	−0.110	0.012	0.000
Financial reasons for owning index	−0.025	0.161	0.014	0.080
Knowledge of AF	0.159	−0.070	0.063	0.012
Age	−0.004	0.192	0.003	0.273
College graduate (No = 0)	0.278	−0.154	0.086	0.001
<i>F</i> -value	7.838			
Adj. <i>R</i> ²	0.287			
<i>N</i>	239			

The results pertaining to farming orientation and landownership motivation suggest an interesting pattern. The relationship between environmental and recreational reasons for owning land and interest in agroforestry was strongly positive. Financial motivation, on the other hand, was negatively associated with interest in agroforestry, although the parameter estimate was not significant at the 0.05 level ($P = 0.08$). Taken together, these results point to a divide between landowner types. Non-operator landowners who place greater importance on the aesthetic, natural and recreational value of landownership are more interested in agroforestry. For those landowners for whom financial considerations are paramount, agroforestry appears to be less attractive.

The significance of percentage of land in crops reinforces the above interpretation. Non-operator landowners who had a higher percentage of land in crops were considerably less likely to express interest in agroforestry. This result suggests that non-operator landowners may view row crops and trees as incompatible. Row crops are generally planted in the most fertile (and valuable) ground, and landowners may simply have a difficult time imagining that alternative uses—particularly relatively unfamiliar ones such as agroforestry—would be more productive. A second source of incompatibility may be

collective memory of the conversion of forested areas into cropland. As Raedeke et al. (2003, p. 72) put it, “converting the land back to trees could be perceived as erasing an important symbol of previous generations and of a person’s family heritage.”

Finally, also consistent with expectations, both knowledge of agroforestry and level of education were significantly and positively related to the dependent variable. Landowners who know more about agroforestry practices are more likely to express interest in them for their land. This finding should be encouraging to agroforestry proponents given that the direction of the relationship could have been negative. Education level appears to be relevant, as college graduates tended to be more interested in agroforestry than their counterparts with a high school education or less. Age was not significantly related to the dependent variable.

Discussion and conclusion

Several conclusions can be drawn from the results of this study that are potentially important to the agroforestry community. First, even though overall level of interest was relatively low, non-operator landowners did express interest in implementing agroforestry practices on their land. Although this

study measured only interest in agroforestry rather than actual adoption, interest is a critical first step that signals openness to the idea of agroforestry.

Perhaps the most striking conclusion that can be drawn from this research is how differences in farming orientation may be tied to non-operator landowner interest in agroforestry. The results indicate that non-operator landowners with closer ties to farming and stronger financial motivations for landownership are less interested in agroforestry. Efforts to promote agroforestry among such landowners probably will hinge on economic performance rather than environmental or social considerations. A number of articles in *Agroforestry Systems* have called for more intensive efforts to demonstrate and quantify the financial benefits of agroforestry (e.g., Mercer and Miller 1998) and additional research on markets for agroforestry products (e.g., Gold et al. 2004). Our findings further highlight the importance of such efforts to reduce uncertainty and increase interest in agroforestry practices.

On the other hand, the findings point to opportunities for agroforestry promotion among non-operator landowners who place high importance on the environmental and recreational values of their land. For such landowners, interest in adoption may be driven more by the aesthetic and conservation-oriented dimensions of agroforestry rather than simple productive potential. People who have purchased land in rural areas for (perhaps future) retirement, people who earn their living in urban areas and inherit land, people who purchase working farms for hunting purposes, and others who do not necessarily depend on their land for the bulk of their livelihoods may give environmental, aesthetic, and recreational factors more weight than financial ones when making land-use decisions. Further research into the environmental and aesthetic goals of such landowners could inform the design of agroforestry practices tailored to their objectives.

The finding that number of contacts with natural resources professionals is associated with higher interest in implementation of agroforestry practices is also a potentially important one. Non-operator landowners in our study areas who have worked with NRPs are clearly open to the concept of agroforestry. Research has shown, however, that NRPs lack knowledge of agroforestry and rarely promote it (Workman et al. 2003; Workman and Allen 2004). If

interest in agroforestry among non-operator landowners who work with NRPs is to be translated into implementation of practices, further efforts to increase agroforestry knowledge and comfort level among NRPs may be needed.

Overall, the results of this study suggest that more extensive outreach efforts specifically targeting non-operator landowners are warranted. It is important to keep in mind that non-operator landowners do not always have a dominant influence over the selection of agricultural activities on their land (Constance et al. 1996). Nevertheless, non-operator landowners would exert significant influence over decisions involving adoption of agroforestry practices. Given that a large and growing proportion of US farmland is owned by non-operator landowners, a failure to concentrate some research and outreach effort on this group could result in lost opportunities to encourage agroforestry adoption.

Acknowledgements This work was funded through the University of Missouri Center for Agroforestry under cooperative agreements 58-6227-1-004 with the ARS and C R 826704-01-2 with the US EPA. The results presented are the sole responsibility of the authors and/or the University of Missouri and may not represent the policies or positions of the EPA. Any opinions, findings, conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the US Department of Agriculture.

References

- Allen JC, Bernhardt K (1995) Farming practices and adherence to an alternative-conventional agricultural paradigm. *Rural Sociol* 60:297–309
- Clearfield F, Osgood BT (1986) Sociological aspects of the adoption of conservation practices. Soil Conservation Service, Washington, DC
- Constance DH, Rikoon JS, Ma JC (1996) Landlord involvement in environmental decision-making on rented Missouri cropland: pesticide use and water quality issues. *Rural Sociol* 61:577–605
- Economic Research Service (2003) Agricultural resources and environmental indicators. Washington, DC
- Featherstone AM, Goodwin B (1993) Factors influencing a farmer's decision to invest in long-term conservation improvements. *Land Econ* 69:67–81
- Feder G, Umali DL (1993) The adoption of agricultural innovations: a review. *Technol Forecast Soc Change* 43:215–239
- Fliegel FC (1993) Diffusion research in rural sociology: the record and prospects for the future. Greenwood Press, Westport, CT
- Fraser EDG (2004) Land tenure and agricultural management: soil conservation on rented and owned fields in southwest British Columbia. *Agric Human Values* 21:73–79

- Gold MA, Godsey LD, Josiah SJ (2004) Markets and marketing strategy for agroforestry specialty products in North America. *Agroforest Syst* 61:371–382
- Koontz TM (2001) Money talks-but to whom? financial versus nonmonetary motivations in land use decisions. *Soc Nat Resour* 14:51–65
- Kurtz WB (2000) Economics and policy in agroforestry. In: Garrett HE, Reitveld WJ, Fisher RF (eds) *North American agroforestry: an integrated science and practice*. American Society of Agronomy, Madison, WI
- Lockeretz W (1990) What have we learned about who conserves soil? *J Soil Water Conserv* 45:517–523
- Mercer DE (2004) Adoption of agroforestry innovations in the tropics: a review. *Agroforest Syst* 61:311–328
- Mercer DE, Miller RP (1998) Socioeconomic research in agroforestry: progress, prospects, priorities. *Agroforest Syst* 38:177–193
- National Agricultural Statistics Service (2001) *Agriculture economics and land ownership survey (1999)*. Washington, DC
- Newton RR, Rudestam KE (1999) *Your statistical consultant: answers to your data analysis questions*. Sage Publications, Thousand Oaks, CA
- Nowak PJ, Korsching PF (1998) The human dimension of soil and water conservation: a historical and methodological perspective. In: Pierce FJ, Frye WW (eds) *Advances in soil and water conservation*. Ann Arbor Press, Chelsea, MI
- Pannell DJ (1999) *Uncertainty and adoption of sustainable farming systems*. University of Western Australia, Department of Agricultural and Resource Economics, Nedlands, Australia
- Pattanayak SK, Mercer DE, Sills EO, Yang J (2003) Taking stock of agroforestry adoption studies. *Agroforest Syst* 57:173–186
- Raedeke AH, Dunn EG, Rikoon JS, Nilon CH, Kurtz WB (1998) Human dimensions of ecosystem management: a case study of landowner decision making in Brush Creek watershed. University of Missouri College of Agriculture, Food, and Natural Resources, Columbia, MO
- Raedeke A, Green JJ, Hodge S, Valdivia C (2003) Farmers, the practice of farming, and the future of agroforestry: an application of Bourdieu's concepts of field and habitus. *Rural Sociol* 68:64–86
- Rogers EM (2003) *Diffusion of innovations*. Free Press, New York
- Salamon S, Farnsworth RL, Bullock DG, Yusuf R (1997) Family factors affecting adoption of sustainable systems. *J Soil Water Conserv* 52:265–271
- Soule MJ, Tegene A, Wiebe KD (2000) Land tenure and the adoption of conservation practices. *Am J Agric Econ* 82:993–1005
- Traore N, Landry R, Amara N (1998) On-farm adoption of conservation practices: the role of farm and farmer characteristics, perceptions, and health hazards. *Land Econ* 74:114–127
- Workman SW, Allen SC (2004) *The practice and potential of agroforestry in the Southeastern United States*. Institute for Food and Agricultural Sciences, Gainesville, FL
- Workman SW, Bannister ME, Nair PKR (2003) Agroforestry potential in the Southeastern United States: perceptions of landowners and extension professionals. *Agroforest Syst* 59:73–83