PATHS TO AGROFORESTRY: LANDOWNER TYPES, LAND USE AND PERCEPTIONS

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The undersigned, appointed by the Dean of the Graduate School, have examined the thesis entitled

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And hereby certify that in their opinion it is worthy of acceptance.

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ABSTRACT

Land in the United States is predominantly owned by private individuals and families, and has traditionally been used for economic profit through agricultural or timber production. However, U.S. landownership patterns are changing, and an increasing number of landowners are acquiring land for non-monetary, amenity-based reasons. These changes impact landscapes and effective delivery of agroforestry and natural resource-based education and technical assistance programs. This thesis examines the adoption of conservation practices, landowner typologies, environmental concern and attitudes, and changing motivations for landownership to explore the relationships between landowner types, land use orientation, perceptions of trees and knowledge and interest in agroforestry practices. Two models of landowner types are utilized, one based on the distance landowners live from their land, the second based on their current or former involvement in agriculture.

Introduction

The United States presents unique challenges for comprehensive ecosystem management because the majority of its land is privately owned. While private landowners make decisions over their own land use, the environmental impacts of their decisions are felt far beyond ownership boundaries. In order to meet growing environmental challenges, landowners must be engaged and empowered to make environmentally-sound decisions. Efforts to encourage landowners to make responsible environmental choices have traditionally focused on conservation practices appropriate for adoption by farmers. Agroforestry, the integration of trees with farming, is one set of practices promoted to improve agricultural production while conserving and improving land, air and water resources.

While agriculture continues to be an important use of land in the United States, landownership trends are changing—there are fewer farmers and an increase of landowners with smaller parcels who consider their land as a place to consume amenities rather than a space for production. To create success in addressing environmental concerns, all landowners will have to play a role. The purpose of this study is to determine the relationship between landowner types and land uses and perceptions, and how each of these variables in turn relates to knowledge and interest in agroforestry. Two models of landowner types were developed: 1) a standard typology based on self-identification by research participants, including current farmers (both part-time and full-time farmers), non-operator landowners living on their land, and non-operator landowners living away from their land; and 2) a typology that is based on landowners'

experience with agriculture, including current farmers, those who have previously farmed, and those who have never farmed.

Background and Setting

Landownership in the United States and Missouri

The majority of land in the United States (over 60%) is privately owned (Lubowski, et al., 2006, p. 35). Agricultural land, including cropland, grassland pasture and range, grazed forestland, and land in farmsteads, farm roads and lanes, accounted for 1.2 billion acres or just under 52% of the total landmass in the United States in 2002 (Lubowski, et al., 2006, p. 1). Non-grazed forestland comprised the next largest amount of land in the same year with 517 million acres (Lubowski, et al., 2006, p. 2). Rural residential land is a growing category in the United States, and has increased 29% between 1997 and 2002, with an average increase of 1.7 million acres per year since 1980. Rural residential land is an estimate by USDA-ERS of the acres of land and associated lots in rural areas used for housing based on data from the American Housing Surveys and the Census Bureau (Lubowski, et al., 2006, p. 28-30). According to the Natural Resources Conservation Service (NRCS), 121,000 km^2 were converted to urban developments between 1982 and 1997 alone (Agarwal, et al., 2002).

The rate of private ownership of land involved in agriculture in the United States is even higher than the overall national average, including 99% of cropland and 61% of grassland pasture and range (Lubowski, et al., 2006, p. 36). In Missouri, 67.9% of the state's land was considered part of a farm in 2002, and thus was included in the 2002 Census of

Agriculture. The percentage includes 29.9 million acres of land farmed and 106,797 farms in 2002. These numbers are down slightly from 30.2 million acres of land farmed and 110,986 farmers in Missouri in 1997 (U.S. Census of Agriculture, 2002). In 1982 there were 29.3 millions acres of land farmed and 112,447 farmers in Missouri (U.S. Census of Agriculture, 1992), suggesting that land in farms in Missouri is relatively stable, though the number of farms continues to decline.

A majority (56%) of forest-use land in the United States is also privately owned (Lubowski, et al., 2006, p. 36), and there are approximately 10.3 million family (i.e. non-industrial private) forest owners in the US (Butler and Leatherberry, 2004, p. 7). In Missouri, family forest owners control 74% of the forestland (Leatherberry, 2005). Land in private forests is becoming increasingly parcelized, or held in smaller contiguous pieces. Between 1978 and 1994, both the number of owners and the acreage held in small tracts (<100 acres) increased substantially in the United States, and acreage held in tracts of 10-49 acres more than doubled during those 16 years (Birch 1996).

Challenges to sustainability

Sustainable management of land resources is necessary to address growing environmental concerns including air and water quality, soil contamination and soil erosion, and global climate change. Comprehensive, systems level strategies are necessary to positively impact the environment, but are particularly challenging with the number and diversity of stakeholders making land use decisions. Human modification of the landscape has significant impacts on ecology, both in urban-suburban areas and rural areas, and

ecologists are increasingly recognizing the impact of exurban development, or development along the urban-rural fringe, on natural systems. An integration of social and ecological research is necessary to create more policy-relevant science in order to meet these environmental challenges (Theobold, 2004). Changing land use patterns, including increased exurban development, contribute additional challenges to ecologists and natural resource professionals as the extent and impacts of human modifications become a moving target (Agarwal, et al., 2002). The dominance of privately owned land in the United States results in important conservation and environmental decision-making taking place at the private household level. Accurate and adequate technical information on resource conservation must be available to enable private landowners to build on their community consciousness and to prudently use their land resources (Dutcher et al., 2004).

Agroforestry: Potential tool for sustainability

Agroforestry is a group of practices that can be considered as part of a sustainable resource management plan for landowners of both agricultural land and forestland. "Agroforestry practices combine trees and shrubs with crops and/or livestock to increase and diversify farm and forest production while conserving natural resources" (AFTA, 2000, Foreword, para. 1). The Association for Temperate Agroforestry (AFTA, 2000) lists five practices as part of agroforestry in the temperate zone:

1. Alley cropping includes growing an agricultural crop (grain, forage or specialty crop) simultaneously with a long-term tree crop (fine quality hardwoods, nut-

bearing trees or fast-growing hybrid poplar trees), in alleys, to provide two incomes in one space.

2. Silvopasture includes the mixing of trees with livestock grazing systems, to provide shade to livestock, improve forage production of certain types of grasses and legumes, and provide additional income through select harvesting of timber or non-timber forest products.
3. Riparian buffers include plantings of grasses, shrubs and trees to along stream banks to intercept sediments, filter pesticides and excess nutrients. The also stabilize stream banks, protect floodplains, enhance aquatic and terrestrial habitats and provide landowners with harvestable products.
4. Windbreaks are planting of trees that protect crops, livestock and/or buildings by reducing the negative effects of wind, including erosion, rapid evaporation of water, and decreases in energy efficiency.
5. Forest farming includes the growth of high-value specialty crops grown in the shade of forest canopy. Specialty crops include mushrooms, ginseng, goldenseal and decorative ferns and are sold for medicinal, culinary or ornamental uses.

Four of the practices are included in the analysis for this thesis, including alley cropping, silvopasture, riparian buffers and windbreaks. This thesis explores landowner types, including farmers and non-farmers (i.e. non-operator landowners), land use behaviors and landowner perceptions in order to inform practitioners of potential means to increase adoption of agroforestry practices as a conservation strategy.

Review of Literature

Introduction

The research reported in this thesis lies at the intersection of four literatures which are reviewed below. First is the adoption-diffusion literature, specifically the adoption of conservation and agroforestry practices. The adoption literature informs this research by suggesting two potential tools for analysis: the traditional diffusion model and the farm structure-institutional constraints model. The adoption literature also provides recommendations for selecting independent, moderating and dependent variables, units of analysis, and addresses time horizon issues that may be important in studies on landowners and conservation. The second literature relates to landowner typologies, and explores motivations for landownership as well as land use orientations. Much of this literature focuses on amenity versus economic-focused motivations for landownership, and their corresponding implications for land uses. The third literature discusses environmental concern and environmental attitudes, comparing those involved in extractive versus non-extractive occupations and rural residents versus urban residents, as well as discussing the differences in environmental concern and attitudes among different types of farmers. The final literature reports on the changing motivations for landownership and how these motivations impact the definition of land as well as landownership. This literature focuses primarily on the growth in exurban development.

Adoption Diffusion

Adoption of conservation practices

There are a large number of studies considering the adoption of conservation practices by farmers. Camboni et al. (1990) discuss two diffusion models in their study of the Conservation Reserve Program. The traditional diffusion model looks at the adoption of innovation primarily as a decision made by the individual adopter, who must be aware that a problem exists and recognize that options for resolving the problem are available. Other important variables in the traditional diffusion model include personal characteristics of the adopter, their perceptions of profitability associated with adoption, and psychological and social characteristics of potential adopters. The farm structure-institutional constraints model includes institutional characteristics of the agricultural system along with characteristics of the farm enterprise when looking at adoption decisions, and looks at the constraints placed on individual actors by the farming system, and institutional and policy contexts within which their decisions are made.

In his meta-analysis of soil conservation studies, Lockeretz (1990) found that most of the studies fell within three schools of thought: focusing on economic factors, applying adoption-diffusion literature, or exploring the adoption process specific to environmental quality at the exclusion of economic return. Based on his analysis, Lockeretz concludes that there is a need to study a blend of economic and environmental factors in the adoption of conservation practices. Lockeretz also reports that typical independent variables in conservation studies include personal characteristics of farmers and their farms, institutional connections, attitudes on other issues, and the land's physical

potential for erosion. Featherstone and Goodwin (1993) show that studies on the adoption of soil conservation practices in the context of the 1980s farm crisis indicate that financial characteristics like debt and income are the most important factors leading to investment in soil conservation during such times. Dependent variables in conservation studies tend to focus on the use of specific practices or the results of conservation efforts (including erosion rate and water quality measures). Other dependent variables include attitudes toward conservation and perceptions of soil erosion problems. A few studies have developed model chains of variables by treating perceptions of soil erosion problems first as a dependent variable, and then as an independent variable to predict farmers' practices. Additional study is needed to explore perceptions and other potential moderating variables using similar methods. The unit of analysis in these studies tends to be the farm operator, though sometimes research focuses on the landowner and occasionally the tract of land (Lockeretz 1990).

A study of the factors affecting farmers' use and rejection of banded pesticide applications by Rikoon et al. (1996) provides a specific example of a conservation adoption study. This study found a difference in the factors that led farmers to experiment with banding pesticides and the factors that led farmers to adopt or reject banding as a habitual practice. Farmers who tried banding had significantly larger acreages of corn and soybeans, higher gross sales, higher education, greater knowledge of pesticides and the ability to apply their own chemicals. College education, certification as a private applicator and gross sales were the three variables most likely to predict experimentation with the method. Once farmers tried banded pesticide applications, however, it was the

smaller farms who were more likely to continue usage. While banding satisfied farmers' desires to reduce pesticide use and protect water quality, many farmers chose to abandon the practice because it was difficult to incorporate into their own farming system. This study also examined farmers' perceptions about the environmental risk of pesticide use, but found that they did not impact adoption of this practice that could reduce pesticide use. It may be noted that the experimentation with banded pesticides does not require a long-term change in farming philosophy or strategy, which may result in farmers' greater willingness to try the practice. However, without significant up-front investment, farmers can also abandon the practice with little loss.

Conservation practices that require long-term changes in farming approaches likely present a very different set of reasons for adoption. For example, structural conservation practices like terracing require a longer (multi-year) commitment to see results than management practices like changes in tillage or reductions in pesticide use. Farmers may view long-term conservation practices as investments rather than practices to experiment with and potentially adopt. When looking at the adoption of long-term conservation practices, older farmers and livestock producers are less likely to invest in conservation whereas larger farm households, incorporated farms and farms receiving government payments are more likely to invest in conservation (Featherstone and Goodwin 1993). One of the government programs encouraging long-term conservation is the Conservation Reserve Program (CRP), and Bultena et al. (1990) find that the financial considerations important in the adoption of soil conservation practices are also important in CRP participation. However, they also find a number of social factors important to CRP

participation, including perceptions of impacts of CRP and awareness of CRP. As may be expected, lower awareness about CRP led to lower participation.

Camboni et al. (1990) also study participation in the Conservation Reserve Program. Their study uses purposive methods to choose the study area, including the choice of a population that received extensive information about available soil conservation programs. The study found that conventional methods of diffusing information (through the Soil Conservation Service, now NRCS, field staff) are inadequate, particularly among retired farmers. This study also points to the importance of economic benefits and profitability in farmer decision-making. They used knowledge as a dependent variable with participation in government programs, percentage of income from various farm sources and percentage of waterways protected under conservation programs as independent variables. Lack of knowledge is a significant barrier to adoption. Landowners need to know *specific* information of how innovations will affect them. In this study, perceived knowledge did not affect participation in CRP, although awareness of specific eligibility (i.e. how many acres they owned that were eligible) did impact participation positively. The study also found significant variation in the types of farming operations, and that farm specialty impacted perceived knowledge. The authors concluded from this relationship that information needs to be designed and targeted to different farm interest groups.

Other studies go beyond examination of the adoption of specific practices or use of the Conservation Reserve Program, and broaden their view beyond farmers to include all

landowners. Raedeke et al. (2001) explore Ozark landowner participation in an ecosystems management program designed to protect water resources from cattle. The research examines the impacts of personal characteristics, farm structures, and ecological variables on environmental perceptions, perceived impacts on the ecosystem, and landowner interest in participating in an ecosystem management cost-share program. The study compared newer landowners with long-time (oftentimes farming) residents to measure differences between those motivated toward land ownership for amenity consumption reasons versus those motivated for economic, production or extraction reasons. This study calls for a more direct measure like self-identification of farmer identity to provide more conclusive evidence about the relationship between farming identity and landowner interest in ecosystem management programs.

Rapid development and urbanization in some areas across the country add another element to decisions about conservation practices, particularly conservation practices like riparian buffers, where most benefits accrue to society rather than individual landowners. Lynch and Brown (2000) look at grass versus tree riparian buffers, and farmers' choice to keep acreage in agriculture versus selling it for development in a rapidly urbanizing area. The study found that up-front costs for adoption are important, and that there are more barriers to planting tree riparian buffers than grass because of the long time horizon even though tree riparian buffers are more effective at preventing erosion. Furthermore, the potential development value of land is important in farmers' decisions to participate in conservation programs.

Adoption of agroforestry

Agroforestry, the blending of trees with agriculture, is a long-term practice that may be considered as part of a conservation strategy and researchers have begun to evaluate the social and economic impacts of agroforestry under various scenarios. Mercer and Miller (1998) conclude that additional socioeconomic research is needed in the field of agroforestry, and that this work should focus on the adoption decision-making process, rigorous economic analyses of agroforestry systems and the impacts of alternative policies on agroforestry adoption. Through the use of meta-analysis, Pattanayak, et al. (2003) review existing studies on the adoption of agroforestry practices worldwide. Much of this research centers on tropical climates in developing countries, but there are a growing number of studies on temperate agroforestry and agroforestry practiced in developed countries. Pattanayek, et al. (2003) conclude that there are five categories that determine the adoption of agroforestry. The first category is preferences, or farmer-specific influences including risk tolerance, attitudes toward conservation, and intra-household homogeneity. Proxies for these preference variables include demographic characteristics including age, gender, education and social status. Based on their analysis of the existing literature, Pattanayak, et al. (2003) conclude that these demographic characteristics are valid proxies though there are legitimate concerns about the appropriateness of using demographic variables to stand in for preferences. Other categories that determine adoption include resource endowments (assets like land, labor, livestock, savings); market incentives (prices, availability of markets, transportation, and potential income loss or gains); biophysical factors (soil quality, slope of farmland, plot

size); and risk and uncertainty (short-term risk like fluctuating commodity prices, and long-term risks, like land tenure) (Pattanayak, et al., 2003).

There is an emerging body of literature on the adoption of agroforestry based on data sets collected in Missouri by the Center for Agroforestry at the University of Missouri, which utilizes Bourdieu's concepts of field and habitus in examining landowner interest in agroforestry. A field is defined as external in nature, "a network, or a configuration, of objective relations between positions," while habitus is defined as internal in nature and referring to the shared meanings and behaviors utilized by individuals within a social group (Bourdieau and Wacquant, 1992, p. 97). Raedeke, et al. (2003) discuss a number of alternatives for increasing adoption of agroforestry practices in Missouri given the context of field and habitus. The first alternative is to introduce agroforestry into the existing social relations found in agriculture, where significant power is held by actors other than farmers. This would involve the promotion of agroforestry to individuals who control the capital central to farming, including lenders, landlords, and agribusiness entities. A second alternative is to use agroforestry as a means to transform the existing social relations of agriculture, redistribute power and empower farmers through new forms of capital or gains in capital currently held. A final alternative is to develop agroforestry as a field relatively separate from farming altogether.

In his thesis on characteristics of farm operator attitudes and interest in agroforestry, Flower (2004) looked at four attitudinal categories among farmers. These included "disengagers" (farmers who have decided to leave the field of agriculture and are

continually reducing their involvement in agriculture), "conservatives," (farmers who are expansionist oriented, but interested only in new practices that could be considered part of their current field of agriculture), "accumulators" (farmers who are profit and expansion oriented, and interested in new opportunities inside and outside their current field of agriculture), and "lifestyle" (farmers concerned with preserving rural and agricultural way of life, who farm part-time and maintain off-farm employment). His study focused on riparian buffers as an agroforestry practice primarily focused on conservation and forest farming as an agroforestry practice primarily focused on commercial production. He found that both attitudes and farm-structure characteristics are important in determining interest in agroforestry, with the lifestyle attitude being an important predictor of interest in both riparian buffers and forest farming. He also found that knowledge of agroforestry practices heavily influences interest. Valdivia and Poulos (2005) found similar results, concluding that knowledge of practices was the most important predictor of interest, with values and attitudes of farmers also playing an important role in interest. They also found that monetary motivations were not a driving factor in interest. Building on the work from Flower, Valdivia and Poulos, Dorr (2006) included both farm operator and non-operator landowners in her thesis on landowner interest in agroforestry and again found that knowledge of practices increases interest.

The final alternative recommended by Raedeke et al. (2003), which recommends developing agroforestry as a new field separate from agriculture, has gained greater traction in recent studies concentrating on non-operator landowners and their perceptions of agroforestry. Research by Arbuckle et al. (2005) from data collected in 1999 in eastern

Missouri shows that close ties to farming and strong financial motivations for landownership are associated with lower interest in agroforestry, and that promotion of agroforestry practices to this group must focus on economic performance. However, for landowners who place high importance on environmental and recreation values, there is more interest in agroforestry, more economic resources, and higher motivation from non-economic factors.

Landowner Types

As suggested in the literature on the adoption of agroforestry, landowner types and their underlying motivations for landownership play an important role in decision-making about conservation. Paths to landownership, such as whether the landowner inherited their land, are also important, as are the likelihood that the current landowner will pass the land down to someone in his or her family. Studies of conservation have traditionally focused on farm operators, and include an investigation of their practices on both the land they own and rent (Lockeretz 1990). Lists of potential research subjects are often drawn from farm related government agencies like the Natural Resources Conservation Service (NRCS) and the Farm Service Agency (FSA), as in the case of Rikoon et al. (1996).

However, farm operators are not the only stakeholders in conservation efforts. A significant number of studies also study the relationships between landlords and their renters who are farming the land. Constance et al. (1996) looked at landlord involvement in environmental decision-making on rented Missouri farmland, and divided landlords into those residing relatively close to the farmland they own (local) and those living a

greater distance away (absentee). Although there are significant demographic differences between local and absentee landowners in this study, attitudes about pesticide use, perceptions of risk to water quality from pesticide use and levels of environmental stewardship are similar among the two groups. Furthermore, virtually all landlords abdicate most farm decision-making to the renters farming their land, including environmental and conservation decision-making. Some significant differences they did find between types of landlords center around social ties. Local landlords tended to rent their land to family members or people they had known a long time, and many were using rental farmland as a form of transitioning family land from parents to children. On the other hand, absentee landlords seemed to be dominated by a newer generation of landowners with fewer social ties to renters and less agricultural experience. Social ties are important predictors of involvement in environmental decision-making for local landlords, though not for absentee owners. However, greater participation in environmental and conservation decision-making is more tied to economic factors than with social ties for both local and absentee landlords.

As a growing number of landowners come to land ownership through their desire for the amenities of living and recreating in rural landscapes rather than land's productive potential, researchers have begun to include non-agricultural landowners in their studies of conservation. Raedeke et al. (2001) sampled all landowners within the Brush Creek Watershed in south-central Missouri who were included in the Brush Creek EARTH project mailing list and had a Missouri address. They measured the percentage of their lifetime landowners had spent farming in order to look at the impacts of farm background

on interest in participating in an ecosystem management program. Farming background appears to negatively impact interest in this particular conservation program, with landowners who were interested in participating in the ecosystem management spending an average of 34% of their life farming, while uninterested landlords spent an average of 51% of their life farming. Furthermore, landowners with greater farming experience were less interested in the cost-share component than their counterparts with less farming experience.

Koontz (2001) studied all owners of private, noncommercial parcels larger than five acres in his study in Monroe County, Indiana, taking his sample from county tax assessor records. His study focuses on primary motivation for landownership (particularly monetary versus non-monetary motivations), types of activities landowners participate in on their land, landowner reliance on their land for economic livelihood, parcel size, total land holdings, income, educational attainment and age. Based in his findings, Koontz created two ideal types of landowners: those motivated by financial returns and those motivated by non-monetary benefits. Those motivated by financial returns are characterized by engaging in timber harvest, development, farming, haying and/or grazing on their land while those motivated by non-monetary benefits are involved in active protection of their land and/or mowing. Among financially motivated landowners, income gained from their parcel of land is substantially important. They also tend to have larger parcels, larger total land holdings, lower household income, lower educational attainment and are older than their counterparts who are motivated by non-monetary benefits. This research suggests that landowner types and their underlying motivations

have important implications for conservation programs. For example, landowners motivated by financial returns may be enticed into conservation through cost-share, rental payment or tax reduction programs, while those motivated by non-monetary benefits may respond to non-financial incentives like education programs and environmental improvement on their individual parcel.

Arbuckle et al. (2005) came to similar conclusions in their study on landowner interest in agroforestry. They measured attachment to the farming community, farming orientation and landownership motivations, knowledge of agroforestry and demographic characteristics to better understand non-farm-operator landowner interest in agroforestry. They sampled from NRCS and Farm Services Agency databases which included a significant number of non-farming landowners. The results of the study indicate that farming orientation impacts interest in agroforesty, and non-operator landowners with closer ties to farming and stronger financial motivations for landownership are less interested in agroforestry practices. While promotion of agroforestry to these landowners will likely depend on economic performance of agroforestry or economic incentives to adopt agroforestry, landowners who are less tied to agriculture and financial motivations for landownership may be a group worth targeting with agroforestry technologies.

Similar typologies have developed among studies of family forest owners. Butler and Leatherberry (2004) use data from the National Woodland Owner Survey, which focuses on private forest owners, to study the motivations underlying forestland ownership as well as forest management activities. They describe landowners in terms of reasons for

owning family forestland, including aesthetics or nature; privacy for their home, or farm; family legacy; hunting or other recreation; land investment; and timber production. Richter (2005) uses cluster analysis to divide landowners into two categories, legacy and detached, depending on their relationship with land. Legacy landowners tend to have longer family ties to their land, and hope to pass their land on to the next generation. They value aesthetic and experiential aspects of forestland, and have strong conservation objectives. They also tend to participate in a blend of consumptive and non-consumptive land uses. In contrast, detached landowners have neither strong attachments to their land nor strong objectives underlying forestland ownership.

Environmental Concern and Environmental Attitudes

Based on the literature about landowner types, it is clear that underlying motivations and values are important to landowners' decisions about land use and land management. Two important aspects of landowner values are their levels of environmental concern and their environmental attitudes. According to Greenbaum (1995), researchers have found that "anti-environmentalist" attitudes are often associated with two groups. One group includes industrialists like private-sector executives, managers or professionals, especially those in resource extraction or manufacturing industries. Another group includes workers and self-employed people whose jobs are directly related to either resource extraction or pollution-causing activities. Several studies revealed that urban residents who are not involved in extractive industries have higher levels of environmental concern than their rural counterparts. These results are consistent over time, and data from the 1973-1990 General Social Surveys (GSS) show that modest but

consistently higher levels of environmental concern are reported by those currently living in urban areas and persons not employed in resource extractive industries. Based on the same GSS data, age was found to be the best predictor of environmental concern, with younger adults being more concerned about the environment. Political ideology, education and residence at age 16 (urban versus rural) are the second most important predictors, with liberals, well-educated respondents and those raised in urban areas reporting greater concern. (Jones and Dunlap 2001).

Buttel et al. (1981) report on studies that specifically compare farmers with persons with nonfarm occupations, as well as rural residents with urban residents. In the studies reviewed, both farmers and rural residents have lower levels of environmental awareness and concern than non-farming and urban residents. Farm operators also report relatively low levels of concern for agriculturally related environmental problems. Farmers are not uniformly anti-environmental, however. The same studies citing lower concern for the environment among farmers also report significant variation in farmers' attitudes, and indicate that many farmers are making changes on their farms because of environmental and health concerns about conventional farming methods.

Buttel et al. (1981) report on two competing literatures. The first comes from research and theory related to environmental attitudes in the general public. It emphasizes the importance of class status in determining pro-environment attitudes. However, this theory is contradicted by a growing body of evidence that larger, more heavily capitalized and more privileged farmers (i.e. those of higher class status) are more *anti*-environmental

than smaller farmers. The second perspective suggests that larger farmers are anti-environmentalist due their economic orientation toward agriculture, and consider land and other environmental resources as inputs. The results of the study suggest that economic dependence on agriculture, and a resulting economic orientation toward land supersede (i.e. reduce) concern about the environment. Furthermore, as net worth increases (i.e. greater insulation from the need for short-term profits) farmer interest in agriculturally-related environmental concerns increases. In short, once economic needs are met, farmers may be freer to have and act upon concern for the environment. The results from the Buttel et al. (1981) study are partially corroborated by the results found by Constance et al. (1996) in their study on landlord involvement in environmental decision-making in Missouri. Because non-farm landlords, many of whom reside in urban areas, are still mostly interested or dependent on the economic gains from farmland they have rented out, their perceptions and attitudes about the environment are much more closely aligned with farmers than urbanites.

Changing Motivations and the Redefinition of Land

As mentioned earlier, literature on the traditional model of adoption tends to focus on individual decision making. Land and agricultural economists offer one model of landowner decision making, in which individuals make decisions by comparing expected net returns based on the costs and benefits of a particular behavior within the context of their risk preferences (Koontz, 2001, p. 53). Other scholars have explored the non-monetary aspects of farming decisions, including farmers' concern about environmental impacts on their families and society as a whole (Lighthall 1995). One study points to the

importance of non-financial motivations like innovative traditions within the farm family, systematic on-farm experimentation, and environmental or health triggers as key reasons for the adoption of sustainable farming systems, in addition to prudence with resources which can be both financially and non-financially motivated (Salamon 1997).

Non-monetary motivations are perhaps even more important for non-farm (i.e. non-operator) landowners, and there are a growing number of non-farm landowners. Many rural areas, particularly those close to urban areas and in the western United States, are transitioning from extraction or production economies based on mining and agriculture to new economies based on aesthetic landscape or amenity consumption. This transition is occurring as a new set of landowners from urban areas relocate to rural areas (Walker and Fortmann 2003). The new landowners are part of a growing trend toward exurbanization, which Smith and Sharp (2005) define as settlements ranging from "a single farm or nonfarm country residence to relatively large, rural subdivisions outside the boundaries of a municipality." (p. 566). Salamon's study of six Illinois towns explores the impact of exurban migration on traditional agrarian towns. She explains exurban migration as a mix of "push and pull" phenomena, including the pull toward the "safe, friendly, close-to-nature, agreeably scaled, family-focused, peaceful life associated with old, agrarian, small rural towns" and the push away from big-city issues, including drug use and other crimes (Salamon 2003, p. 6). Such exurban sprawl is occurring in rural areas nationwide, and changing the rural landscape from one dominated by agricultural production to include amenity consumption (Salamon 2003). Brogden and Greenberg (2003) call such trends "reterritorialization," a result of competing interest groups' redefinition of the

commodity value of land. In the case of the American Southwest, where their study takes place, urban environmentalists and landowners new to rural areas define the commodity value of land as a place to consume amenities like clean air and water, beautiful landscapes, and wildlife, while ranchers continue to see the land as a source of income and a means to maintain their long-established lifestyle. A study in an exurban region of Ohio highlights differences between farmers and nonfarmers in attitudes about farmer and community relations. Farmers reported greater concern about the effects of growth on local rural character than nonfarmers, and they were more tolerant and accepting of agricultural annoyances than nonfarmers. Both farmers and nonfarmers were supportive of efforts to preserve local farmland. "The existence of these types of differences between farmers and nonfarmers is not surprising, as farmers are presumably more vested in the productive aspects of farming, whereas nonfarmers (both new and longtime residents) are likely less interested in productive uses of the landscape and more interested in aesthetic or quality-of-life issues" (Smith and Sharp 2005, p. 576). In the Southern Appalachian Ecoregion, exurban migrants are strengthening environmental values in rural areas. New migrants report more concern about environmental issues, more environmentally-motivated personal behaviors and higher levels of environmental activism than their lifetime rural resident counterparts (Jones et al., 1999, p. 495).

Because their livelihood is not dependent on income from the land, non-monetary motivations are more important for newer, non-farm (i.e. non-operator) landowners. Koontz (2001) examined land use decisions among both farmers and non-operator landowners, and found that 80% of all land use activities were pursued for non-monetary

benefits. In particular, non-monetary benefits were more important for smaller parcels of land and for landowners with smaller total landholdings, as well as for landowners with higher household income and educational attainment, younger landowners, and those landowners whose income was not dependent on income from the land (p. 61).

Relation of Literature to Thesis

Each of the four literatures reviewed above influenced the development of the research reported in this thesis. The adoption literature provides two models of diffusion, including the traditional model and the farm structure-institutional constraints model (Camboni et al. 1990). While accepting that there are limitations to the traditional diffusion model, my research follows more closely in the tradition of this model in order to explore the importance of individual landowners' perceptions on their knowledge and interest in agroforestry. There is some consideration of institutional factors embedded in my landowner types, which distinguish between landowners who are formerly or currently involved in agriculture and thus influenced by the "institutions" of agriculture, and landowners who report no farming background.

More generally, the adoption literature informs the selection of variables as well as the choice of using landowners as the units of analysis in this study (Lockeretz 1990). It demonstrates a trend in choosing a target population based on its exposure to specific conservation programs or practices (Camboni et al. 1990), and including all landowners, including those without ties to agriculture (Koontz 2001). The literature recommends study of both economic and environmental variables when studying program

participation and adoption of specific practices (Lockeretz 1990). The research indicates that time horizon is an important factor in the adoption of conservation, and there is a difference in the adoption of short-term conservation practices and those requiring a more permanent, long-term commitment (Featherstone and Goodwin 1993). Furthermore, the adoption literature suggests the utilization of methods such as path analysis, which can develop model chains of adoption phenomena, and that perceptions are an important piece of those chains (Lockeretz 1990). The literature focusing on adoption of agroforestry sets a precedence of dividing agroforestry practices based on their orientation toward conservation versus economic or commercial applicability.

The literature on landowner types recommends dividing landowners into categories based on their motivations for land ownership, particularly those motivations which can be classified as economic and non-economic (Koontz 2001). A slightly different way of classifying landowner types is through their current or former relationship to extractive industries like agriculture (Raedeke et al. 2001, Arbuckle et al. 2005). Raedeke et al. (2001) call for a more direct measure of farmer identity to provide more conclusive evidence about the relationship between farming identity and landowner interest in ecosystem management programs. One such direct measure is the self-identification of research participants on a spectrum of farm and non-farm categories. Others have divided their landowner types based on the distance between the land they own and their residence (Constance et al. 1996), or the strength of their relationship with their land (Richter 2005).

There is considerable overlap in the literatures on landowner types and those addressing environmental concern and attitudes, as well as the literature which captures changing motivations in landownership and the redefinition of land. For the purposes of this study, the important highlights from these literatures are the differences between landowners that are primarily motivated by economic or extraction factors and those who are most interested in non-economic or amenity factors (Koontz 2001, Greenbaum 1995), and the increase in landowners interested in amenity factors (Brogden and Greenberg 2003, Walker and Fortmann 2003).

Methods and Procedures

Justification of the Study

According to USDA, "land-use changes have important economic and environmental implications for commodity production and trade, open space, soil and water conservation, and other policy issues" (Lubowski, 2006, p. iv). A growing number of landowners, especially those with smaller parcels, can be defined as exurban, and they are purchasing or holding land for non-monetary benefits, including aesthetics, hobbies and recreation (Koontz, 2001; Walker and Fortmann, 2003). Understanding the shift in landownership patterns and motivation, from economically-motivated production taking place on the land to amenity-based consumption of land resources, is essential for overall sustainable resource management because it enables policy interventions to be targeted to the diversity of landowner needs. While financial incentives like cost-share and tax benefits can be successful among landowners motivated by economic reasons, non-financial interventions (like landowner education and outreach) may be more effective in reaching landowners who own land for non-monetary reasons (Koontz, 2001).

Purpose of the Study

The purpose of this study is to determine the relationship between landowner types and land uses and perceptions, and how each of these variables in turn relates to knowledge and interest in agroforestry. Two models of landowner types have been developed: 1) a standard typology based on self-identification by research participants, including current farmers (both full-time and part-time farmers), non-farming landowners living on their land, and non-farming landowners living away from their land; and 2) a typology that

distinguishes between landowners who are currently farming, those who previously farmed, and those who have never farmed.

Research Problem

How does landowner type relate to land use and perceptions among landowners in four Missouri counties? How do landowner type, land use and perceptions affect knowledge and interest in agroforestry among landowners in four Missouri counties?

Research Objectives

1. Describe the demographic characteristics (age, gender, marital status and education) and land/farm characteristics (number of acres owned, likelihood of passing land to a family member, number of years land in family, gross revenue from agricultural products and percent of gross income from farming in the last three years) of landowners included in the study.
2. Describe landowner types, non-agricultural land uses, and perceptions of the obstacles and benefits of planting trees.
3. Describe knowledge and interest in agroforestry.
4. Determine the relationship between landowner type and knowledge and interest in agroforestry.
5. Determine the relationship between landowner type and non-agricultural land uses and perceptions of obstacles and benefits of planting trees, and how non-agricultural land use and perceptions on planting trees in turn affect knowledge and interest in agroforestry.

Research Questions

The four broad questions addressed in this research include:

1. **How does landowner type directly relate to perceptions of the obstacles and benefits of planting trees when obstacles and benefits are categorized based on their economic value or amenity value? How does landowner type relate to non-agricultural land use?**

Based on the literature reviewed, it is expected that individuals involved in extraction from their land will have higher perceptions of economic obstacles and benefits of planting trees than those who are not involved in extraction. In this study, involvement in extraction is operationalized as "current farming;" those who are not involved in extraction are non-farming landowners either living on their land or living away from their land. Landowners' perceptions of economic obstacles and benefits are measured as perceptions of economic obstacles to planting trees and perceptions of economic benefits of planting trees.

It is also expected that those who are not involved in extraction from their land will have higher perceptions of amenity benefits and will have a greater number of non-agricultural land uses than their farming counterparts. In Model 2, it is expected that those who have previously farmed will have continued impact from their farming background in terms of both perceptions and non-agricultural land uses, and will fall between those who are currently farming and those who have never farmed but more closely resemble those currently farming.

2. **How does landowner type directly relate to knowledge and interest in agroforestry when agroforestry practices are divided into economically-focused and conservation-focused practices?**

The direct relationship expected between landowner type and knowledge and interest in agroforestry practices are similar to the relationships between landowner type and perceptions and non-agricultural land uses outlined above in question one. It is expected that those who are currently farming will have more knowledge and interest in the economically-focused agroforestry practices, while those who are not farming will have more knowledge and interest in the conservation-focused agroforestry practices. Again, those who previously farmed (measured in Model 2) are expected to fall between those who are currently farming and those who have never farmed, but to be more closely aligned with those who are currently farming.

3. **How do perceptions of the obstacles and benefits of planting trees and non-agricultural land use directly relate to knowledge and interest in agroforestry when agroforestry practices are divided into economically-focused and conservation-focused practices?**

It is expected that the perceptions of the economic obstacles to planting trees, the perceptions of the economic benefits of planting trees, the perceptions of the amenity benefits of planting trees and non-agricultural land uses will have significant, direct relationships with economically-focused agroforestry practices and conservation-focused agroforestry practices.

4. **Do perceptions of the obstacles and benefits of planting trees and non-agricultural land use serve as mediating or intervening variables (i.e. have indirect effects)?**

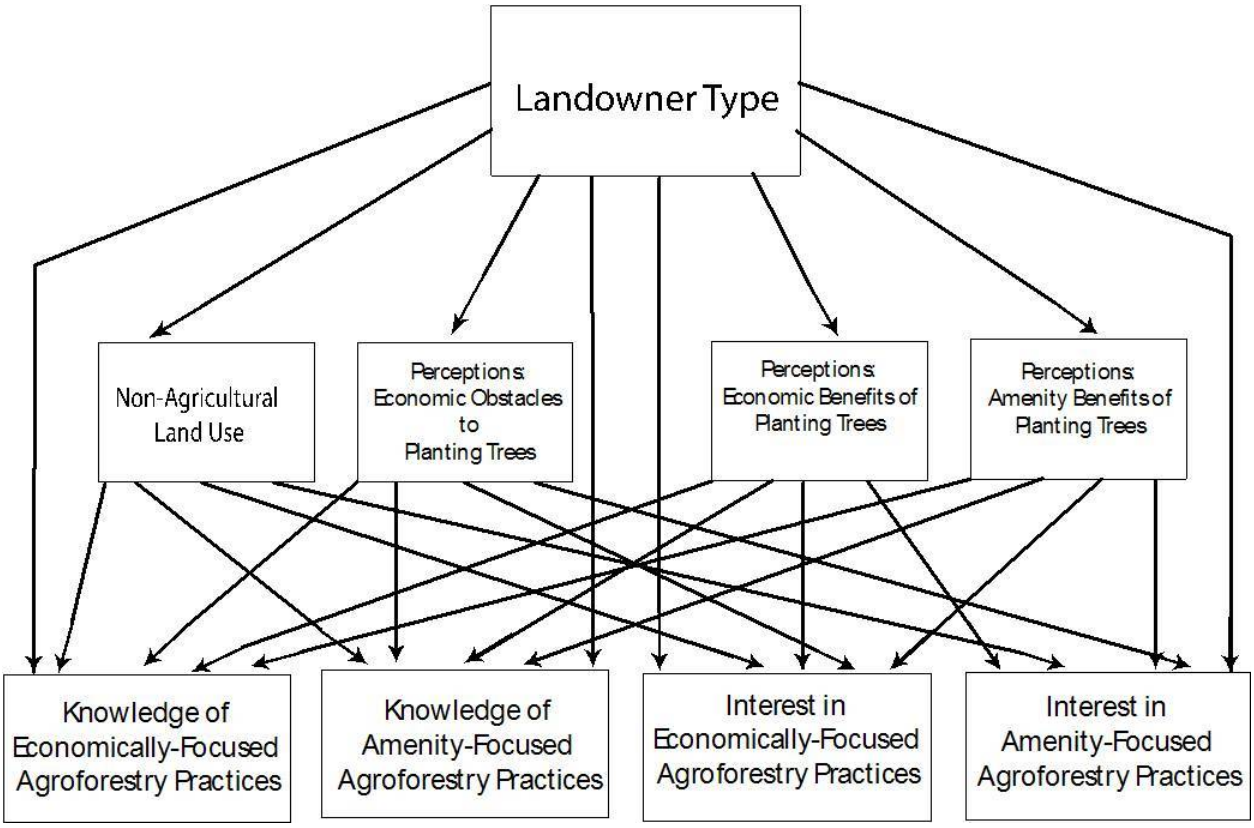
The phenomenon of a variable or set of variables being tested as mediating or intervening variable(s) is intended to demonstrate the indirect effects of the original or independent

variable (in this case landowner type) on the dependent variables of interest (in this case knowledge and interest in agroforestry). This analysis is commonly known as path or process analysis. It is expected that in this study perceptions of the obstacles and benefits of planting trees and non-agricultural land use will serve as mediating or intervening variables and account for indirect effects between landowner type and knowledge and interest in agroforestry practices.

Conceptual Framework

This research explores the direct relationship between landowner type and knowledge and interest in agroforestry, as well as the relationship between landowner type and land use behaviors and perceptions as mediating variables on such knowledge and interest. (See the chart included below to see the conceptual framework in graphic form.) The conceptual framework includes landowner type as the independent variable; non-agricultural land use, perceptions of the economic obstacles to planting trees, perceptions of economic benefits to planting trees and perceptions of the amenity benefits of planting trees as mediating variables; and interest and knowledge of economically-focused and conservation-focused agroforestry practices as the four dependent variables.

Figure 1. Conceptual Framework



Two models of landowner types

Two different models of landowner types are applied. Model 1 depicts landowner types based on self-identification by research participants, including the categories of current farmer, non-farming landowner living on their land and non-farming landowner living away from their land. This landowner typology is developed to show the impact of extractive or productive land uses on landowners' perceptions and non-agricultural land uses, as well as knowledge and interest in agroforestry. This model also considers whether living on land or living away from land that you own has an impact on those variables. Model 2 depicts landowner types based on their experience with agricultural production, in order see the relationship between current or former producer orientation

and current land use behaviors, perceptions, knowledge and interest. Landowners in model two are also split into three groups: those who are currently farming, those who previously farmed and those who have never farmed.

Limitations of the Study

The population studied in this thesis is private landowners with 10 or more acres in four Missouri counties, and results from the study can only be generalized to this population. In addition, enumerators were used to increase the speed of data collection. This may have resulted in less consistent responses because of variations in interview administration.

Methods

Research Design

The research in this thesis is primarily exploratory, and combines descriptive and correlational approaches as described in Ary, Jacobs and Razavieh (2002). Descriptive research "asks questions about the nature, incidence, or distribution of variables" (p. 558), while correlational research "attempts to determine the extent and the direction of the relationship between two or more variables" (p. 557). This thesis also utilizes the concept of mediating variables found in Kenny (2006).

The independent variable in this research is landowner type; mediating or intervening variables include non-agricultural land use and perceptions of the obstacles and benefits of planting trees; and the dependent variables are knowledge and interest in agroforestry.

Two models of landowner types are tested: Model 1 includes respondents' self-identification as a farmer, a non-operator landowner living on their land or a non-operator landowner living away from their land; the categories in Model 2 are based on respondents' relationship with agriculture, including currently farming, previously farmed and never farmed.

Mediating variables are included that build on suggestions reported in Pattanayak et al. (2003) to measure preferences and perceptions directly, as well as on Lockeretz's (1990) suggestion to measure actual behavior of landowners. There are a total of four mediating variables studied, and they are treated as both independent and dependent variables in the regression analysis (see analysis reported below). The perceptions of the obstacles to planting trees included are economic in nature. The perceptions of the benefits of planting trees are divided into two separate variables to reflect both economic benefits and amenity benefits.

The dependent variables (knowledge and interest in agroforestry) are divided into practices which are primarily economic-focused (silvo-pasture and alley cropping) and those which are primarily conservation-focused (windbreaks and riparian buffers), in order to determine the relationships between landowner types and economic versus non-economic practices. This results in a total of four dependent variables (knowledge and interest in economic-focused practices and knowledge and interest in conservation-focused practices). Forest farming was excluded from the analysis based on the results of previous studies which aligned this practice closely with the lifestyle attitudinal category.

The lifestyle attitudinal category includes farmers concerned with preserving rural and agricultural way of life, who farm part-time and maintain off-farm employment. This thesis combines part-time and full-time farmers into one category (Valdivia and Poulos, 2005; Flower, 2004).

Data Collection

Sampling for this study combined purposive and probabilistic sampling methods. Purposive sampling methods were used to select two regions of Missouri for their proximity to University of Missouri Research Farms that include active University of Missouri Center for Agroforestry research projects, increasing the likelihood that area landowners had been exposed to agroforestry practices. The regions chosen were mid-Missouri, home to the Horticulture and Agroforestry Research Center (HARC) in New Franklin, Howard County; and the Northeast Ozarks, including the Wurdack Research Center in Cook Station, Crawford County. Two counties within each region were chosen for the study. One county in each region (Howard and Crawford) included the agroforestry research center and was primarily rural in nature. The second county in each region was chosen because it is contiguous with the selected rural county and it includes an urban center. In mid-Missouri, Boone County was chosen because it includes the city of Columbia; in the Northeast Ozarks, Phelps County was chosen because it includes the city of Rolla. According to 2005 tax assessor records in each of the counties, the total number of landowners with more than 10 acres (excluding public agencies, development companies and non-farm commercial properties) included 6,272 landowners in Boone

County; 1,592 in Howard County; 3,892 in Crawford County; and 1,675 in Phelps County.

Probabilistic sampling methods were used to select subjects for the study. A sampling frame of all landowners with 10 or more acres of land in each of the four counties was secured from each county's tax assessor's office, following the example laid out by Koontz (2001). Duplicate names and commercial or non-private landowners (i.e. government agencies, churches, development companies, non-farm businesses, etc.) were purged from the list. The remaining landowners were sorted by alphabetical order and assigned a number. A random sample of 6100 numbers with replacement (4000 for the mid-Missouri region and 2100 for the Northeast Ozarks region) were drawn from www.random.org/nform.html, and the list was purged of duplicate numbers. Respondents were selected in order from the numbers drawn until 360 interviews were successfully completed. The overall response rate (i.e. successful interviews completed) was 25.95%, including a 24.3% response rate for Crawford County, 35% response rate for Phelps County, 26.9% response rate for Howard County and 23.6% response rate for Boone County. The overall refusal rate (i.e. landowner was contacted and refused participation) was 25.75%, including a 20.4% refusal rate in Crawford County, 19.4% in Phelps, 33.6% in Howard and 30.3% in Boone. The remaining 48.3% of names drawn fell into the following categories: no phone (19.15%), no answer (15.45%), repeated random number (7.0%), wrong number (2.75%), enumerator quit (1.55%), mistake (.45%), development company (.65%), and deceased (.30%). See Table 1 below for detailed information on response rate, compiled and reported in Arbuckle and Dorr (2006).

Table 1. Response Rate

Category		Crawford	Phelps	Total	Howard	Boone	Total
Interview	#	113	63	176	60	124	184
Completed	%	24.3	35	27.3	26.9	23.6	24.6
No Phone	#	107	48	155	31	76	107
	%	23	26.7	24	13.9	14.5	14.3
No Answer	#	73	23	96	27	93	120
	%	15.7	12.8	14.9	12	17.7	16
Refused	#	95	35	130	75	159	234
Participation	%	20.4	19.4	20.2	33.6	30.3	31.3
Repeated	#	33	7	40	18	40	58
Random #	%	7.1	3.9	6.2	8	7.6	7.8
Wrong	#	9	0	9	7	24	31
Number	%	1.9	0	1.4	3.1	4.5	4.1
Moved	#	12	0	12	2	0	2
	%	2.6	0	1.9	.8	0	.3
Enumerator	#	18	2	20	0	0	0
Quit	%	3.9	1.1	3.1	0	0	0
Mistake	#	2	1	3	3	0	3
	%	.4	.6	.5	1.3	0	.4
Development	#	0	1	1	0	8	8
Company	%	0	.6	.2	0	1.5	1.1
Deceased	#	3	0	3	0	1	1
	%	.6	0	.5	0	.1	.1
Totals	#	465	180	645	223	525	748
	%	100	100	100	100	100	100

Enumerators (i.e. interviewers) were used to gather data through face-to-face interviews with respondents. The interviews strictly adhered to the questionnaire developed. Enumerators were hired from the local area to benefit from their local knowledge and to decrease travel costs. Enumerators were compensated $50 per completed questionnaire; each interview was approximately one hour in length. Enumerators received a day-long training session conducted by personnel from University of Missouri Center for Agroforestry, and faculty and graduate students in agricultural economics and rural

sociology. The training covered basic information on agroforestry, orientation to the questionnaire and the sample, tips on securing a good response rate, and hands-on practice with the questionnaire. Enumerators were responsible for contacting and arranging interviews with their assigned interviewees and accommodating respondents by meeting them in a convenient location for the interview. Enumerators were instructed to call each potential respondent five times, on varying days and times of the day, before determining that the potential respondent was not reachable. Enumerators were monitored as they returned completed interview schedules to ensure quality control.

Instrumentation

To ensure the validity of the instrument used for this research a team of agricultural economists and rural sociologists at the University of Missouri developed the questionnaire with input from foresters and other scientists involved in agroforestry research. It is based on two questionnaires originally used to gather data for a study in Southeast Missouri conducted in 1999: one of the original questionnaires was used with non-operator landowners; the other questionnaire was used with farmers. The questionnaire for this study targeted both non-operator landowners and farmers. It includes additional questions on organizational membership, and reflects changes in government programs since 1999. To determine reliability, the instrument was field tested with three types of landowners in central Missouri: row-crop farmers, livestock producers and non-operator landowners.

Variables

Landowner type in Model 1 is determined by the respondents' self-identification as a part-time farmer, full-time farmer, non-operator landowner living on their land, or non-operator landowner living away from their land. The categories of part-time farmer and full-time farmer were combined so the category had an adequate number of responses to run analyses. Respondents were also asked if they ever farmed land that they owned and, the number of years they farmed as an adult. Information from these questions was used to construct the second model of landowner types, with categories currently farming, previously farmed and never farmed as an adult.

Respondents were asked a series of yes/no questions about their non-agricultural land use, including walking/hiking, wildlife/nature viewing, hunting, fishing, camping, using off-road recreational vehicles, horseback riding, and gathering mushrooms, berries or other wild edibles (Question #39). These responses were developed into an index variable (NONAGUSE) with a scale from 0-8, as reported in Table 2 below.

Respondents were also asked about their perceptions of planting trees, including both obstacles to planting trees and benefits of planting trees. The perception variables were measured with a Likert scale and developed into the index variables reported below. Perceived obstacles to planting trees (Question #54) were measured by respondents on a five-point scale, from "1" (no influence on respondent interest in planting trees) to "5" (very large influence on interest in planting trees). The perceived obstacles included in the analysis are economic in nature and are developed into an index variable (PER:

OBST) with a scale from 5-25. For the descriptive analysis, perceptions of obstacles to planting trees were divided into three categories: cases who responded between 5-11 on the scale were counted as perceiving low influence of economic obstacles; those responding between 12-18 were counted as medium influence; and those between 19-25 were counted as high influence. The index includes measurements of negative effects on crops, inadequate market prices for timber, costs of establishing and managing trees, inconvenience for running farm equipment and the long time required for making a profit from trees.

Perceived benefits of planting trees (Question #53) were measured by respondents on a four-point scale from "1" (unimportant) to "4" (very important). Perceptions of the benefits of planting trees are divided into two variables in this analysis, including perceptions of economic benefits of planting trees (PER: ECON) and perceptions of the amenity benefits of planting trees (PER: AMNTY). Economic benefits include economic benefits, erosion control and tax benefits; amenity benefits include wildlife, scenic beauty, and water quality. The scales for each perception of benefits question is from 3-12. The corresponding values for the descriptive analysis are also the same for both perceptions of benefits questions, with 3-6 considered low importance, 7-9 considered medium importance and 10-12 considered high importance.

Table 2. Index Variables: Non-Agricultural Land Use and Perceptions of Planting Trees

Variable Name	**Survey Question**
NONAGUSE (Scale 0-8)	Does anybody do the following on your land on a regular basis (1=yes; 0=no)? -Walking/hiking -Wildlife/nature viewing -Fishing

-Camping
-Operating off-road recreational vehicles
-Horseback riding
-Gathering mushrooms, berries or other wild edibles
-Hunting

PER: OBST The following is a list of potential obstacles to planting trees. Please indicate how much influence each of the factors would have in reducing your interest in planting trees (1=no influence; 5=very large influence).

(Scale 5-25)
-Negative effects on crops (e.g. weeds, pests, shade, nutrient loss)
-Inadequate market prices for timber
-Costs of establishing and managing trees
-Trees are an obstacle for farm equipment
-Takes too long to make a profit

PER: ECON If you were to consider planting trees on your property, please indicate how important each of the following potential benefits would be to you (1=unimportant; 4=very important).

(Scale 3-12)
-Economic benefits
-Erosion control
-Tax benefits

PER: AMNTY If you were to consider planting trees on your property, please indicate how important each of the following potential benefits would be to you (1=unimportant; 4=very important).

(Scale 3-12)
-Wildlife
-Scenic beauty
-Protect water quality

Respondents were also asked to rank their interest and knowledge in six agroforestry practices during the interview process (see questions 50 and 51 in the attached questionnaire) . Interest was measured on a 4 point Likert scale (1=uninterested; 4=very interested); knowledge was measured on a 5 point Likert scale (1=very low; 5=very high). Responses to questions on four of the practices are used in this study. Alley cropping and silvopasture are grouped together to represent agroforestry practices primarily focused on economic factors (INT: ECON; KNOW: ECON) because they have stronger income potential and are associated with agricultural production. Riparian buffers and windbreaks are grouped as conservation practices (INT: CONSRV; KNOW: CONSRV) due to their emphasis on conservation and ecological benefits, their association with environmental protection and restoration, and their lower likelihood of resulting in direct economic benefit. Both interest variables are measured on a scale from

2-8, with responses of "2" considered as no interest in the descriptive data on practices and "3-8" considered "yes" (some or greater interest) in the descriptive data. Both knowledge variables are measured on a scale from 2-10, with responses of "2-5" considered as low knowledge of agroforestry practices and "6-10" considered high knowledge in the descriptive data.

Data Analysis

Three methods of data analysis are enlisted to explore the relationships between landowner types, land use, perceptions, knowledge and interest. The Chi-Square Test of Independence is utilized to determine differences between landowner types in terms of age, gender, marital status, education, number of acres owned, non-agricultural land uses, number of years land has been in the family, likelihood of passing land on, gross revenue from agricultural products and percent of gross income that comes from farming. Chi-Squares are also used to determine if there are differences between landowner types on non-agricultural land use, perceptions of the economic obstacles to planting trees, perceptions of the economic benefits of planting trees, perceptions of the amenity benefits of planting trees, interest and knowledge in economically-focused agroforestry practices and interest and knowledge in conservation-focused agroforestry practices. Bivariate analysis is used to determine correlation between many of these variables. Both Chi-Square and bivariate analyses are based on the methods described in Ari et al. (2002).

Finally, mediation analysis is used to explore direct and indirect relationships between the independent variable and the dependent variables to give a more complete picture of how one affects the other, and how mediating (or intervening) variables may play a role (Kenny 2006, Alwin and Hauser 1975). In this study, mediation analysis is used to explore direct and indirect relationships between the independent variable landowner type and the dependent variables knowledge and interest of economically-focused agroforestry practices as well as knowledge and interest of conservation-focused agroforestry practices. Mediating variables included in the analysis include non-agricultural land use, perceptions of the economic obstacles to planting trees, perceptions of the economic benefits of planting trees and perceptions of the amenity benefits of planting trees. To determine the total effect, each mediating variable is placed in a regression equation along with the independent variable (landowner type), with knowledge and interest in economically-focused agroforestry practices and conservation-focused agroforestry practices as the dependent variables. Two models of landowner types were used: the first utilizes each respondent's self-identified category (farmer, landowner living on the land but not farming the land, or landowner living away from the land and not farming the land; the second distinguishes among those who are currently farming, those who previously farmed and those who have never farmed.

The original data set included 360 cases. However, in order to complete the analysis detailed above, some cases were removed due to missing data on key questions. Sixty-two cases (17.2%) with missing data were removed, leaving a total number of 298 cases in the analysis.

Results

Model 1 Descriptive Data on Demographic and Land Characteristics

In Model 1, respondents are divided into three categories which describe their current involvement with their land: non-farming landowners living away from the land they own (n=55), non-farming landowners living on their land (n=181), and those landowners who are currently farming (n=112). Table 3 (below) shows a comparison of key demographic and land characteristics between the three groups. As may be expected, there is a significant difference between the three categories on the number of acres owned, as well as gross revenue from agricultural products and percentage of gross income from farming over the past three years. It is somewhat surprising that non-farm landowners living away from their land tend to fall closer to those who are currently farming on these three key measures than do their non-farming counterparts who are living on the land they own. These three figures, combined with the fact that non-farming landowners living away from their land have the highest average number of years that land has been in the family (41.9 years) than either non-farmers living on their land (29.8 years) or those who are currently farming (35.6 years), indicates that these absentee landowners are likely inheritors of family land. Those with a legacy of landownership tend to hold a closer relationship with their land than those who did not inherit their land (Richter 2005).

Table 3. Model 1. Demographic and Land Characteristics by Landowner Type

	Non-Farm Landowner, Living Away	**Non-Farm Landowner, Living on Land**	**Currently Farming**
Gender			
Male	79.5%	69.4%	79.5%
Female	20.5%	30.6%	20.5%
Marital Status			
Married	82.1%	79.6%	86.6%
Never Married	2.6%	2.0%	1.8%

Divorced/Separated	5.1%	10.2%	6.3%
Widow/widower	10.3%	8.2%	5.4%
Education			
Less Than High School	5.1%	4.8%	6.3%
High School	25.6%	39.5%	42.9%
Some College	25.6%	17.7%	17.9%
College or Greater	43.6%	38.1%	33.0%
Number of Acres Owned* **			
10-20	17.9%	31.3%	8.9%
21-40	12.8%	27.9%	10.7%
41-80	7.7%	19.7%	20.5%
81-120	20.5%	6.8%	8.0%
121+	41.0%	14.3%	51.8%
Likelihood of Passing Land to Family Member			
Very Unlikely	35.9%	32.0%	15.2%
Unlikely	15.4%	19.0%	19.6%
Unsure	12.8%	12.2%	10.7%
Likely	12.8%	13.6%	14.3%
Very Likely	20.5%	22.4%	37.5%
MEANS			
Age	58.6	58.1	56.5
Number of Years Land in Family	41.9	29.8	35.6
Non-Agricultural Land Uses (Scale: 0-8)	4.0	3.8	4.3
Gross Revenue from Ag Products* **	$3,923	$803	$36,135
% Gross Income from Farm (last 3 years)* **	9.0%	7.9%	32.8%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

Model 1 Descriptive Data on Mediating and Dependent Variables

As shown in Table 4 below, there is a statistically significant difference between Model 1 landowner types and non-agricultural land use. The vast majority of landowners are using their land for at least one non-agricultural purpose, including 84.6% of non-farming landowners living away from their land, 92.5% of non-farming landowners living on their land and 97.2% of landowners currently farming. Those who are currently farming and those are not farming and living away are the most active in non-agricultural land use, with 63.6% and 61.5% reporting four or more of the non-agricultural land uses measured respectively. However, those who are not farming and living away are most likely to

report no non-agricultural land use (15.4%) while it is rare for those who are currently farming to report no non-agricultural land use (2.7%).

Hunting is reported as the most common non-agricultural land use among all three landowner types, with 80.4% of those currently farming, 74.4% of non-farming landowners living away from their land and 66.0% of non-farming landowners living on their land reporting that their land is used for hunting on a regular basis. Walking or hiking is another common land use with 64.1% of non-farmers living away and 60.5% of non-farmers living on their land reporting that their land is used for such purposes on a regular basis. In contrast, just 43.8% of landowners currently farming report that their land is used for walking or hiking on a regular basis. Non-farming landowners living away from their land report the highest levels of using their land for camping and gathering mushrooms, berries, etc., with 41% reporting that their land is used for each of those purposes on a regular basis. Just 17.0% of non-farming landowners living on their land and 18.8% of those currently farming are also using their land for camping, and 33.3% and 29.5% using their land for gathering mushrooms, berries, etc., respectively.

The trend of non-farm landowners living away from their land being closer to those currently farming than non-farm landowners living on their land is again apparent when examining non-agricultural land use (see Table 2 to see the components of the index). The mean of non-agricultural land use on a scale from 0-8 was 4.0 for non-farm landowners living away from their land, 3.8 for non-farm landowners living on their land and 4.3 for those currently farming. By running a comparison of means with LSD, there

is a statistically significant difference between those currently farming and non-farm landowners living on their land.

Table 4: Model 1. Non-Agricultural Land Use by Landowner Type

	Non-Farm Landowner, Living Away	**Non-Farm Landowner, Living on Land**	**Currently Farming**
NONAGUSE*			
None	15.4%	7.5%	2.7%
1-3	23.1%	37.4%	33.6%
4 +	61.5%	55.1%	63.6%
Walking/Hiking	64.1%	60.5%	43.8%
Wildlife/Nature Viewing	51.3%	65.3%	52.7%
Fishing	48.7%	36.1%	59.8%
Camping	41.0%	17.0%	18.8%
Operate Off-Road Vehicles	46.2%	39.5%	53.6%
Horseback Riding	12.8%	24.5%	47.3%
Gather mushrooms, berries, etc.	41.0%	33.3%	29.5%
Hunting	74.4%	66.0%	80.4%
Non-Agric. Land Use (Mean on 0-8 Scale)*	4.0	3.8	4.3

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

There are few statistically significant differences between Model 1 landowner types in terms of their perceptions of planting trees as seen in Table 5 below. However, perceptions of economic obstacles to planting trees (PER: OBST) shows the most striking difference, with 20.5% of those currently farming indicating economic obstacles as highly important, while just 10.3% of non-farm landowners living away from their land and 10.2% of non-farm landowners living on their land rank them high.

As may be expected, those who are currently farming report a large or very large influence of obstacles directly relating to farming more often than those who are not farming, including the perception that planting trees will have negative effects on crops

and the perception that planting trees is an obstacle for farm equipment. Almost a third of those who are currently farming (31.3%) consider the negative effects on crops to have large or very large influence in their decision-making compared to just 15.4% of non-farmers living away from their land and 11.6% of non-farmers living on their land. More than a third of those who are currently farming (39.3%) report that the perception that planting trees is an obstacle for farm equipment has a large or very large influence. Less than one-fifth (18.3%) of non-farmers living on their land and just 15.4% of non-farmers living away from their land report similar perceptions. Other perceptions of economic obstacles follow similar patterns. Over half (56.4%) of those currently farming report a large or very large influence from their perception that the costs of establishing and managing trees is an obstacle to planting trees, compared with just 39.5% of non-farmers living on their land and 20.5% of non-farmers living away from their land. Almost half (46.4%) of those currently farming report a large or very large influence of the perception that it takes too long to make a profit from trees compared to 33.4% of non-farmers living on their land and 18.0% of non-farmers living away from their land.

Table 5: Model 1. Perceptions of the Economic Obstacles to Planting Trees by Landowner Type

	Non-Farm Landowner, Living Away	**Non-Farm Landowner, Living on Land**	**Currently Farming**
PER: OBST* **			
Low	69.2%	53.7%	33.0%
Medium	20.5%	36.1%	46.4%
High	10.3%	10.2%	20.5%
Negative effects on crops			
No influence	53.8%	55.8%	35.7%
Little influence	15.4%	19.7%	15.2%
Moderate influence	15.4%	12.9%	17.9%
Large or very large influence	15.4%	11.6%	31.3%

Inadequate market prices for timber			
No influence	43.6%	44.2%	34.8%
Little influence	20.5%	19.7%	18.8%
Moderate influence	12.8%	17.7%	16.1%
Large or very large influence	23.0%	18.3%	30.4%
Costs of establishing/managing trees			
No influence	30.8%	23.1%	20.5%
Little influence	15.4%	11.6%	17.0%
Moderate influence	33.3%	25.9%	16.1%
Large or very large influence	20.5%	39.5%	56.4%
Obstacle for farm equipment			
No influence	59.0%	59.2%	28.6%
Little influence	12.8%	14.3%	13.4%
Moderate influence	12.8%	8.2%	18.8%
Large or very large influence	15.4%	18.3%	39.3%
Takes too long to make a profit			
No influence	46.2%	42.9%	18.8%
Little influence	20.5%	12.9%	15.2%
Moderate influence	15.4%	10.9%	19.6%
Large or very large influence	18.0%	33.4%	46.4%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

As seen in Table 6 below, however, there are no statistically significant differences between Model 1 landowner types in terms of their perceptions of the economic benefits of trees (PER: ECON). There is little difference between groups even when examining the individual variables that comprise the economic benefits index, including economic benefits, tax benefits and erosion control. However, there are important differences in the perceptions of the amenity benefits of planting trees (PER: AMNTY), where non-farm landowners living away from their land rank them as highly important more than half the time (51.3%), and non-farm landowners living on their land rank them as highly important 46.9% of the time. Just 33.9% of those who are currently farming consider the amenity benefits of planting trees as highly important. Perhaps the most striking difference can be seen in the wildlife benefits of planting trees, where 53.8% of non-

farmers living away from their land rate their perceptions of benefits of planting trees for wildlife as very important. Less than a third (31.3%) of those currently farming and just 42.9% of non-farmers living on their land ranked wildlife benefits as very important.

Table 6: Model 1. Perceptions of the Economic Benefits and Amenity Benefits of Planting Trees by Landowner Type

	Non-Farm Landowner, Living Away	**Non-Farm Landowner, Living on Land**	**Currently Farming**
PER: ECON			
Low	30.8%	40.1%	36.6%
Medium	38.5%	38.1%	33.9%
High	30.8%	21.8%	29.5%
Economic benefits			
Unimportant	30.8%	38.8%	33.9%
Slightly important	30.8%	23.8%	17.0%
Moderately important	17.9%	17.7%	24.1%
Very important	20.5%	19.7%	25.0%
Tax benefits			
Unimportant	35.9%	45.6%	37.5%
Slightly important	23.1%	14.3%	16.1%
Moderately important	23.1%	17.0%	20.5%
Very important	17.9%	23.1%	25.9%
Erosion control			
Unimportant	17.9%	21.1%	18.8%
Slightly important	12.8%	13.6%	16.1%
Moderately important	20.5%	21.8%	26.8%
Very important	48.7%	43.5%	38.4%
PER: AMNTY*			
Low	28.2%	19.7%	33.9%
Medium	20.5%	33.3%	31.2%
High	51.3%	46.9%	33.9%
Wildlife			
Unimportant	17.9%	13.6%	25.9%
Slightly important	10.3%	10.9%	14.3%
Moderately important	17.9%	32.7%	28.6%
Very important	53.8%	42.9%	31.3%
Scenic beauty			
Unimportant	23.1%	16.3%	22.3%
Slightly important	10.3%	14.3%	21.4%
Moderately important	33.3%	28.6%	33.9%
Very important	33.3%	40.8%	22.3%
Protecting water quality			

Unimportant	17.9%	25.9%	21.4%
Slightly important	15.4%	8.8%	15.2%
Moderately important	20.5%	28.6%	32.1%
Very important	46.2%	36.7%	31.3%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

As seen in Table 7 below, there are no statistically significant differences in interest and knowledge of agroforestry among Model 1 landowner types. However, it is interesting to note (though not statistically significant) that non-farmers living away from their land report the highest levels of interest in the economically-focused agroforestry practices of alley cropping and silvopasture, with 46.2% of that group reporting at least slight interest. On the other hand, just 29.3% of non-farmers living on their land and 35.7% of current farmers do. Furthermore, it is interesting to note that the highest levels of interest in the conservation-focused agroforestry practices are among those currently farming (51.8%), with 48.7% of non-farmers living away from their land and 41.5% of non-farmers living on their land also reporting interest in the conservation-focused practices. Landowners report the highest overall interest in riparian buffers, over the other three practices included in the analysis. Again it is the non-farmers living away from their land who have the highest levels of interest in riparian buffers, with 17.9% reporting that they are very interested. This compares with 10.9% of non-farmers living on their land and 8.0% of those currently farming who are very interested in riparian buffers. When comparing results for the interest and knowledge variables, it is encouraging for agroforestry practitioners to note that landowners' interest in conservation is relatively even with their knowledge, and interest in the economically-focused agroforestry practices actually

exceeds the knowledge base. Under these circumstances, greater outreach and diffusion of technological information may very well increase adoption of agroforestry practices.

Table 7: Model 1. Interest and Knowledge in Agroforestry Practices by Landowner Type

	Non-Farm Landowner, Living Away	**Non-Farm Landowner, Living on Land**	**Currently Farming**
INT: ECON			
No	53.8%	70.7%	64.3%
Yes	46.2%	29.3%	35.7%
Alley Cropping			
Uninterested	79.5%	80.3%	85.7%
Slightly interested	10.3%	6.8%	8.9%
Moderately interested	10.3%	8.8%	3.6%
Very interested	0.0%	4.1%	1.8%
Silvopasture			
Uninterested	66.7%	78.2%	65.2%
Slightly interested	20.5%	6.1%	13.4%
Moderately interested	7.7%	9.5%	14.3%
Very interested	5.1%	6.1%	7.1%
INT: CONSRV			
No	51.3%	58.5%	48.2%
Yes	48.7%	41.5%	51.8%
Windbreaks			
Uninterested	74.4%	68.7%	64.3%
Slightly interested	7.7%	9.5%	13.4%
Moderately interested	10.3%	14.3%	13.4%
Very interested	7.7%	7.5%	8.9%
Riparian Buffers			
Uninterested	53.8%	71.4%	62.5%
Slightly interested	17.9%	4.8%	17.0%
Moderately interested	10.3%	12.9%	12.5%
Very interested	17.9%	10.9%	8.0%
KNOW: ECON			
Low	89.7%	84.4%	84.8%
High	10.3%	15.6%	15.2%
Alley Cropping			
Very Low	56.4%	55.8%	48.2%
Low	20.5%	21.1%	27.7%
Medium	17.9%	15.6%	18.8%
High	2.6%	6.8%	5.4%
Very High	2.6%	0.7%	0.0%
Silvopasture			

Very Low	51.3%	56.5%	43.8%
Low	25.6%	23.1%	32.1%
Medium	20.5%	12.2%	19.6%
High	2.6%	6.8%	4.5%
Very High	0.0%	0.7%	0.0%
KNOW: CONSRV			
Low	59.0%	55.1%	53.6%
High	41.0%	44.9%	46.4%
Windbreaks			
Very Low	20.5%	22.4%	23.2%
Low	25.6%	13.6%	16.1%
Medium	41.0%	38.1%	33.0%
High	7.7%	17.0%	20.5%
Very High	5.1%	8.8%	7.1%
Riparian Buffers			
Very Low	38.5%	36.7%	30.4%
Low	17.9%	22.4%	30.4%
Medium	25.6%	22.4%	22.3%
High	15.4%	12.9%	11.6%
Very High	2.6%	5.4%	5.4%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

Model 2 Descriptive Data on Demographic and Land Characteristics

In Model 2, respondents are divided into three categories of landowner types: those who never farmed (n=107), those who previously farmed (n=79), and those who are currently farming (n=112). "Currently farming" includes both full-time and part-time farmers. As seen in Table 8, age and marital status are fairly consistent across all three groups. However, there is a statistically significant difference in education, with those who have never farmed reporting the highest level of educational attainment and those who are currently farming showing the lowest. A statistically significant difference between these groups also exists in terms of gender, demonstrating that women respondents have less farming experience. As may be expected, the number of acres owned, gross revenue from agricultural products and percent of gross income from farming also vary across groups

in a statistically significant manner, with those currently farming registering the highest means in all three categories, and those who never farmed reporting the lowest. Non-agricultural land use follows the same pattern, with those who have never farmed reporting a mean of 3.5 non-agricultural land uses, and those who previously farmed showing a mean closer to those that are currently farming (4.2 and 4.3 respectively). The differences between Model 2 groups on non-agricultural land uses are statistically significant.

Generational aspects of land attachment can be an important variable in landowner decision-making and include both landowners' hopes to pass land on to family members and their family heritage of landownership (Richter 2005). In this study, the likelihood of passing land to a family member varies significantly across groups. Those with farming experience show the greatest likelihood of passing land on to a family member, with 51.8% of current farmers and 43.0% of those who previously farmed stating that they are likely or very likely to do so. Only 29.9% of respondents who never farmed reported that they are likely or very likely to pass their land to a family member. The number of years land has been in the family is also statistically significant, with those who previously farmed reporting the highest mean number of years at 41.1. Those who are currently farming report a mean of 35.6 years while those who have never farmed have a mean of just 25.7 years.

Table 8. Model 2. Demographic and Land Characteristics by Landowner Type

	Never Farmed	Previously Farmed	Currently Farming
Gender**			
Male	62.6%	83.5%	79.5%
Female	37.4%	16.5%	20.5%
Marital Status			
Married	82.2%	77.2%	86.6%
Never Married	1.9%	2.5%	1.8%
Divorced/Separated	8.4%	10.1%	6.3%
Widow/widower	7.5%	10.1%	5.4%
Education**			
Less Than High School	1.9%	8.9%	6.3%
High School	32.7%	41.8%	42.9%
Some College	28.0%	7.6%	17.9%
College or Greater	37.4%	41.8%	33.0%
Number of Acres Owned***			
10-20	34.6%	20.3%	8.9%
21-40	31.8%	15.2%	10.7%
41-80	15.9%	19.0%	20.5%
81-120	8.4%	11.4%	8.0%
121+	9.3%	34.2%	51.8%
Likelihood of Passing Land to Family Member***			
Very Unlikely	44.9%	16.5%	15.2%
Unlikely	12.1%	26.6%	19.6%
Unsure	12.1%	12.7%	10.7%
Likely	7.5%	21.5%	14.3%
Very Likely	22.4%	21.5%	37.5%
MEANS			
Age	56.5	60.7	56.5
Number of Years Land in Family**	25.7	41.1	35.6
Non-Agricultural Land Uses (Scale: 0-8)*	3.5	4.2	4.3
Gross Revenue from Agricultural Products***	$194	$3,168	$36,135
% Gross Income from Farming (last 3 years)***	4.4%	13.2%	32.8%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

Model 2 Descriptive Data on Mediating and Dependent Variables

The results of the descriptive analysis for Model 2 landowner types are similar to those reported for Model 1 above. In Model 2, landowners are split into three categories based on their orientation toward farming including those who have never farmed, those who

have previously farmed, and those who are currently farming. Non-agricultural land use (see Table 9) follows a similar pattern as in Model 1, with those who have never farmed reporting a mean of 3.5 non-agricultural land uses, and those who previously farmed showing a mean closer to those that are currently farming (4.2 and 4.3 respectively). There are statistically significant differences between landowner types in non-agricultural land use (NONAGUSE), with over 63% of those with former or current agricultural experience using their land for four or more of the non-agricultural purposes measured while those who have never farmed are using their land for four or more such purposes only 51.4% of the time. Perhaps most striking is that 13.1% of those who have never farmed are also not using their land for any of the non-agricultural uses measured, while just 2.7% of those currently farming and 3.8% of those who previously farmed reporting a similar lack of use.

Table 9: Model 2. Non-Agricultural Land Use and Perceptions of Planting Trees and Interest and Knowledge in Agroforestry by Landowner Type

	Never Farmed	**Previously Farmed**	**Currently Farming**
NONAGUSE*			
None	13.1%	3.8%	2.7%
1-3	35.5%	32.9%	33.6%
4 +	51.4%	63.3%	63.6%
Non-Agricultural Land Uses (Scale: 0-8)*	3.5	4.2	4.3
Walking/Hiking	65.4%	55.7%	43.8%
Wildlife/Nature Viewing	65.4%	58.2%	52.7%
Fishing	29.9%	50.6%	59.8%
Camping	20.6%	24.1%	18.8%
Operate Off-Road Vehicles	36.4%	46.8%	53.6%
Horseback Riding	18.7%	26.6%	47.3%
Gather mushrooms, berries, etc.	62.5%	68.4%	68.8%
Hunting	55.1%	84.8%	80.4%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

As in Model 1, the perception of the economic obstacles to planting trees shows statistically significant differences between the three landowner types (see Table 10). More than two-thirds (66.9%) of landowners who are currently farming rate the importance of the economic obstacles to planting trees (PER: OBST) as medium or high, whereas those who previously farmed and those who have never farmed rate economic obstacles as being of low importance, 49.4% and 62.6% respectively. Not surprisingly, more respondents in the category that are currently farming considered the economic obstacles to planting trees that are specific to agriculture as having a large or very large influence than the other two groups. Almost one third of those currently farming (31.3%) considered negative effects on crops as having a large to very large influence, while only 6.1% of those who previously farmed and 4.7% of those who have never farmed responded in the same fashion. The perception that planting trees are an obstacle to farm equipment follows the same pattern though with less differentiation between groups: 29.3% of those currently farming consider this obstacle as having large or very large influence; 27.9% of those who previously farmed and 10.3% of those who have never farmed felt the same. Every perception of economic obstacles to planting trees followed the same pattern, with the highest percentages of those ranking them as having a large or very large influence coming from the landowners who are currently farming, followed by those who have previously farmed. Those who have never farmed consistently have lower percentages of respondents perceiving that the economic obstacles to planting trees have large or very large influence over their decision-making.

Table 10: Model 2. Perceptions of the Economic Obstacles to Planting Trees by Landowner Type

	Never Farmed	Previously Farmed	Currently Farming
PER: OBST* **			
Low	62.6%	49.4%	33.0%
Medium	32.7%	32.9%	46.4%
High	4.7%	17.7%	20.5%
Negative effects on crops			
No influence	63.6%	44.3%	35.7%
Little influence	17.8%	20.3%	15.2%
Moderate influence	14.0%	12.7%	17.9%
Large to very large influence	4.7%	6.1%	31.3%
Inadequate market prices for timber			
No influence	52.3%	32.9%	34.8%
Little influence	16.8%	24.1%	18.8%
Moderate influence	14.0%	20.3%	16.1%
Large or very large influence	16.8%	22.8%	30.4%
Costs of establishing/managing trees			
No influence	27.1%	21.5%	20.5%
Little influence	13.1%	11.4%	17.0%
Moderate influence	26.2%	29.1%	16.1%
Large or very large influence	33.7%	38.0%	46.4%
Obstacle for farm equipment			
No influence	70.1%	44.3%	28.6%
Little influence	12.1%	16.5%	13.4%
Moderate influence	7.5%	11.4%	18.8%
Large or very large influence	10.3%	27.9%	29.3%
Takes too long to make a profit			
No influence	45.8%	40.5%	18.8%
Little influence	15.0%	13.9%	15.2%
Moderate influence	11.2%	12.7%	19.6%
Large or very large influence	28.0%	32.9%	46.4%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

Model 2 landowner types also show statistically significant differences between landowner types in their perceptions of the economic benefits of planting trees (see Table 11). Landowners' current or prior experience with farming is correlated with higher rankings of the importance of economic benefits of planting trees (PER: ECON), with

63.4% of current farmers and 69.6% of former farmers responding that the economic benefits of trees had medium or high importance. In contrast, just 56.1% of landowners who have never farmed found the economic benefits of planting trees as medium or high importance. The difference between groups is even more pronounced when looking exclusively at the category of high importance, where just 14.0% of landowners who have never farmed placed high importance on the economic benefits of trees while those who previously farmed and those currently farming reported high importance 36.7% and 29.5% respectively. It is interesting to note that erosion control, a variable that impacts farmers' long-term profitability, has the most even distribution of the three economic variables. This may indicate that current involvement in farming and dependence on agriculture for income does not necessarily differentiate farmers from non-farmers in terms of perceptions about long-term economic factors.

Perceptions of the amenity benefits of planting trees (PER: AMNTY), did not show statistically significant differences across landowner groups. Based on the percentage of landowners reporting it as very important, wildlife benefits were the most important for all three groups with 31.3% of those currently farming, 44.3% of those who previously farmed and 45.8% of those who have never farmed considering wildlife as very important. This is consistent with the high level of hunting that all landowner groups reported. As may be expected, those who have never farmed report considerably higher perceptions of the amenity benefits of planting trees than economic benefits, with 46.7% ranking amenity benefits high and just 14.0% ranking economic benefits as high. Interestingly, those who are currently farming report fairly consistent perceptions for both

amenity and economic benefits, with 33.9% of farmers considering amenity benefits and 29.5% of farmers considering economic benefits as highly important. Those who previously farmed report higher importance on perceptions of the amenity benefits of planting trees (49.4% ranking them high) than economic benefits (36.7% ranking high).

Table 11: Model 2. Perceptions of the Economic and Amenity Benefits of Planting Trees by Landowner Type

	Never Farmed	**Previously Farmed**	**Currently Farming**
PER: ECON**			
Low	43.9%	30.4%	36.6%
Medium	42.1%	32.9%	33.9%
High	14.0%	36.7%	29.5%
Economic benefits			
Unimportant	44.9%	26.6%	33.9%
Slightly important	28.0%	21.5%	17.0%
Moderately important	15.0%	21.5%	24.1%
Very important	12.1%	30.4%	25.0%
Tax benefits			
Unimportant	45.8%	40.5%	37.5%
Slightly important	16.8%	15.2%	16.1%
Moderately important	17.8%	19.0%	20.5%
Very important	19.6%	25.3%	25.9%
Erosion control			
Unimportant	21.5%	19.0%	18.8%
Slightly important	15.0%	11.4%	16.1%
Moderately important	21.5%	21.5%	26.8%
Very important	42.1%	48.1%	38.4%
PER: AMNTY			
Low	24.3%	17.7%	33.9%
Medium	29.0%	32.9%	31.2%
High	46.7%	49.4%	33.9%
Wildlife			
Unimportant	15.9%	12.7%	25.9%
Slightly important	9.3%	12.7%	14.3%
Moderately important	29.0%	30.4%	28.6%
Very important	45.8%	44.3%	31.3%
Scenic beauty			
Unimportant	15.9%	20.3%	22.3%
Slightly important	13.1%	13.9%	21.4%
Moderately important	31.8%	26.6%	33.9%

Very important	39.3%	39.2%	22.3%
Protecting water quality			
Unimportant	29.0%	17.7%	21.4%
Slightly important	8.4%	12.7%	15.2%
Moderately important	26.2%	27.8%	32.1%
Very important	36.4%	41.8%	31.3%

*Significance level ≤ .05
**Significance level ≤ .01
*** Significance level ≤ .001

Interest in agroforestry conservation practices (riparian buffers and windbreaks) and knowledge of agroforestry economic practices (alley cropping and silvopature) both show statistically significant differences between Model 2 landowner groups (see Table 12). Overall interest in the economically-focused agroforestry practices was fairly low, with 35.7% of those currently farming, 40.5% of those who previously farmed and 27.1% of those who have never farmed indicated interest in alley cropping and silvopasture. More respondents are interested in agroforestry conservation practices, including 51.8% of those currently farming, 54.4% of those who previously farmed and 34.6% of those who have never farmed reporting some interest. Those who previously farmed showed the most interest in both economically- and conservation-focused agroforestry practices, as well as the highest knowledge in those categories. This may indicate an interest among former farmers to re-enter agriculture if appropriate technology enables them to pursue alternative enterprises consistent with their life stage. Furthermore, as in Model 1, it is encouraging to note that landowners report interest in agroforestry conservation practices at roughly the same rate as their knowledge, and their interest in agroforestry economic practices actually exceeds their current level of knowledge on those practices.

Table 12: Model 2. Interest and Knowledge in Agroforestry Practices by Landowner Type

	Never Farmed	Previously Farmed	Currently Farming
INT: ECON			
No	72.9%	59.5%	64.3%
Yes	27.1%	40.5%	35.7%
Alley Cropping			
Uninterested	86.9%	70.9%	85.7%
Slightly interested	4.7%	11.4%	8.9%
Moderately interested	7.5%	11.4%	3.6%
Very interested	0.9%	6.3%	1.8%
Silvopasture			
Uninterested	79.4%	70.9%	65.2%
Slightly interested	9.3%	8.9%	13.4%
Moderately interested	8.4%	10.1%	14.3%
Very interested	2.8%	10.1%	7.1%
INT: CONSRV**			
No	65.4%	45.6%	48.2%
Yes	34.6%	54.4%	51.8%
Windbreaks			
Uninterested	73.8%	64.6%	64.3%
Slightly interested	8.4%	10.1%	13.4%
Moderately interested	10.3%	17.7%	13.4%
Very interested	7.5%	7.6%	8.9%
Riparian Buffers			
Uninterested	78.5%	53.2%	62.5%
Slightly interested	7.5%	7.6%	17.0%
Moderately interested	5.6%	21.5%	12.5%
Very interested	8.4%	17.7%	8.0%
KNOW: ECON**			
Low	92.5%	75.9%	84.8%
High	7.5%	24.1%	15.2%
Alley Cropping			
Very Low	58.9%	51.9%	48.2%
Low	23.4%	17.7%	27.7%
Medium	15.0%	17.7%	18.8%
High	2.8%	10.1%	5.4%
Very High	0.0%	2.5%	0.0%
Silvopasture			
Very Low	60.7%	48.1%	43.8%
Low	24.3%	22.8%	32.1%
Medium	12.1%	16.5%	19.6%
High	2.8%	10.1%	4.5%
Very High	0.0%	2.5%	0.0%
KNOW: CONSRV			

Low	61.7%	48.1%	53.6%
High	38.3%	51.9%	46.4%
Windbreaks			
Very Low	26.2%	16.5%	23.2%
Low	17.8%	13.9%	16.1%
Medium	34.6%	44.3%	33.0%
High	15.0%	15.2%	20.5%
Very High	6.5%	10.1%	7.1%
Riparian Buffers			
Very Low	41.1%	31.6%	30.4%
Low	24.3%	17.7%	30.4%
Medium	19.6%	27.8%	22.3%
High	11.2%	16.5%	11.6%
Very High	3.7%	6.3%	5.4%

**Significance level ≤ .01

Bivariate Analysis

The results of bivariate analysis for both Models 1 and 2 are shown below in Tables 13 and 14. In Model 1, landowner types are treated as ordinal, with the order based on the descriptive statistics reported above (1=non-farm landowner, living on land; 2=non-farm landowner living away; 3=currently farming). Based on the descriptive statistics above, this order may depict level of active engagement with the land and historical connection to land. Landowner types for Model 1 show a statistically significant, slightly negative relationship (-.126*) with perceptions of the amenity benefits of planting trees and a moderately positive relationship (.228***) with the perceptions of economic obstacles to planting trees. Age negatively correlates with a number of variables in a statistically significant manner, including interest in both economic and conservation-targeted agroforestry practices (-.218*** and -.208*** respectively), and perceptions of both economic and amenity benefits of planting trees (-.334*** and -.360*** respectively). While education levels do not correlate with perceptions of the economic obstacles of planting trees, there is a positive relationship between education and perceptions of the

economic and amenity benefits of planting trees (.185*** and .319*** respectively), as well as interest and knowledge in agroforestry practices aimed primarily at conservation (.149** and .214 respectively).

Perceptions of the economic benefits to planting trees demonstrate moderate correlation with interest in agroforestry economic practices (.393***), and both interest and knowledge in agroforestry conservation practices (.420*** and .318*** respectively). There is also a small correlation between perceptions of economic benefits of planting trees and knowledge of economic agroforestry practices (.183**). Perceptions of amenity benefits of planting trees show moderate correlations with interest in agroforestry conservation practices (.382***), interest in agroforestry economic practices (.291***) and knowledge of agroforestry conservation practices (.292***). There is also a small correlation between the perceptions of the amenity benefits of planting trees and knowledge of the agroforestry economic practices (.183**). The strongest correlations are between the two interest categories (.552***), the two knowledge categories (.616***) and the two perceptions of benefits categories (.684***). These results may demonstrate that a major strength of agroforestry is its multi-functionality, including both amenity and economic benefits.

In the bivariate analysis reported below for Model 2, landowner types are treated as an ordinal variable, with level of farming orientation determining the order (1=never farmed; 2=previously farmed; 3=currently farming). Because the same variables are used in the bivariate analysis of Model 2 (other than landowner type), the results of the bivariate

analysis for Model 2 landowner types are identical to those reported above for Model 1, with the exception of the correlations involving landowner type (the column titled LO: TYPE2 in Table 14 below). For Model 2 landowner types we find that landowner type is again positively correlated with the perceptions of obstacles (.299***) with similar strength to the relationship reported for Model 1 landowner types (.228***). One difference between the models is the correlation between interest of agroforestry conservation practices and landowner type, which is statistically significant for Model 2 (.147*) but not for Model 1 (.026). Another difference is that the perceptions of the amenity benefits of trees is significantly correlated with Model 1 landowner types (-.126*), but it is not significant in Model 2 (-.112).

Based on the results for both landowner type models, it may be worthwhile to target younger, better educated landowners with information about agroforestry rather than focusing on landowner types defined by their current level of land use or their current or former orientation toward farming.

Table 13: Model 1. Correlations Between Significant Demographic Variables, Landowner Type, Non-Agricultural Land Use, Perceptions, Interest, and Knowledge

	AGE	ED	LO: TYPE1	NONAG USE	PER: OBST	PER: ECON	PER: AMNTY	INT: CONSRV	INT: ECON	KNOW: CONSRV	KNOW: ECON
AGE	1										
ED	-.188***	1									
LO: TYPE 2	.058	-.062	1								
NONAG USE	-.030	-.057	.104	1							
PER: OBST	-.015	-.077	.228***	.074	1						
PER: ECON	-.334***	.185***	.059	.143*	.193***	1					
PER: AMNTY	-.360***	.319***	-.126*	.026	-.045	.684***	1				
INT: CONSRV	-.208***	.149**	.026	.042	.016	.420***	.382***	1			
INT: ECON	-.218***	.055	.015	-.043	.128*	.393***	.291***	.552***	1		
KNOW: CONSRV	-.037	.214***	.003	.013	.025	.318***	.292***	.302***	.105	1	
KNOW: ECON	-.026	.100	.046	-.045	.059	.183**	.148*	.108	.182***	.616***	1

*Correlation significant at .05 level (2-tailed)
**Correlation significant at .01 level (2-tailed)
***Correlation significant at .001 level (2-tailed)

Table 14: Model 2. Correlations Between Significant Demographic Variables, Landowner Type, Non-Agricultural Land Use, Perceptions, Interest, and Knowledge

	AGE	ED	LO: TYPE2	NONAG USE	PER: OBST	PER: ECON	PER: AMNTY	INT: CONSRV	INT: ECON	KNOW: CONSRV	KNOW: ECON
AGE	1										
ED	-.188***	1									
LO: TYPE 2	.000	-.090	1								
NONAG USE	-.030	-.057	.101	1							
PER: OBST	-.015	-.077	.299***	.074	1						
PER: ECON	-.334***	.185***	.104	.143*	.193***	1					
PER: AMNTY	-.360***	.319***	-.112	.026	-.045	.684***	1				
INT: CONSRV	-.208***	.149**	.147*	.042	.016	.420***	.382***	1			
INT: ECON	-.218***	.055	.084	-.043	.128*	.393***	.291***	.552***	1		
KNOW: CONSRV	-.037	.214***	.065	.013	.025	.318***	.292***	.302***	.105	1	
KNOW: ECON	-.026	.100	.120	-.045	.059	.183**	.148*	.108	.182***	.616***	1

*Correlation significant at .05 level (2-tailed)
**Correlation significant at .01 level (2-tailed)
***Correlation significant at .001 level (2-tailed)

Mediation Analysis

Model 1

Step 1: Test the relationship between independent variable and the dependent variables. Run regression equations with landowner type as the independent variable and the knowledge and interest in agroforestry as the dependent variables.

Table 15: Model 1. Regression Coefficients and Significance Levels for Landowner Type on Knowledge and Interest in Agroforestry

	Model 1 Landowner Type	
	Regression Coefficient	Significance Level
Knowledge in Agroforestry		
KNOW: ECON	.084	.425
KNOW: CONSRV	-.007	.957
Interest in Agroforestry		
INT: ECON	.023	.796
INT: CONSRV	.049	.649

We can see from the results reported in the table above that Model 1's Landowner Typology shows neither strong nor significant relationship with knowledge of economically-focused agroforestry practices like alley cropping or silvopasture (KNOW: ECON); the regression coefficient for this relationship is just .084 and the significance is .425. Model 1's Landowner Typology shows a slightly negative relationship with knowledge of conservation-focused agroforestry practices like windbreaks and riparian buffers (KNOW: CONSRV) at -.007, but this relationship is not significant either (p=.957). Interest in economically-focused agroforestry practices (INT: ECON) and interest in conservation-focused agroforestry practices (INT: CONSRV) also show weak and insignificant relationships, .023 (p=.796) and .049 (p=.649) respectively. The results

from step one indicate that Model 1 Landowner Typology does not directly predict knowledge and interest in agroforestry.

Step 2: Test the relationship between the independent variable and the mediating variables. Run regression equations with landowner type as the independent variable and land use, perceptions of the obstacles to planting trees and perceptions of the benefits of planting trees as dependent variables.

Table 16: Model 1. Regression Coefficients and Significance Levels for Landowner Type on Mediating Variables

	Model 1 Landowner Type	
	Regression Coefficient	Significance Level
Non-Agricultural Land Use		
NONAGUSE	.285	.026
Perceptions of Economic Obstacles to Planting Trees		
PER: OBST	1.37	.000
Perceptions of Benefits of Planting Trees		
PER: ECON	.182	.312
PER: AMNTY	-.393	.030

The table above reports the results of the regression equation using Model 1 landowner type to predict the four mediating variables in the model: non-agricultural land use (NONAGUSE), perceptions of the economic obstacles to planting trees (PER: OBST), perceptions of the economic benefits of planting trees (PER: ECON), and perceptions of the amenity benefits of planting trees (PER: AMNTY). While most of the relationships reported here are also small, a few of them are statistically significant. Non-agricultural land use shows a slightly positive predicted relationship (.285) at the .026 significance level, indicating that those who are currently farming may be using their land for more

non-agricultural uses than those who are not farming, or non-farming landowners who are living away from their land may be utilizing its non-agricultural potential more than those non-farming landowners who live on their land (or some combination of the two). Perceptions of the amenity benefits of planting trees (PER: AMNTY) shows a slightly negative predicted relationship (-.393) at the .030 significance level. This suggests that as you move from non-farming landowners living on their land to non-farming landowners living away from their land to landowners who are currently farming, there is a decrease in the perceptions of the amenity benefits of planting trees. Perceptions of the economic obstacles to planting trees (PER: OBST) has the highest coefficient of all the variables (1.37), as well as the most significant at .000. This indicates that of all the mediating variables tested here, landowner type is the most successful at predicting the perceptions of economic obstacles to planting trees. In contrast, the coefficient for perceptions of the economic obstacles is neither strong (.183) nor significant (.312).

Step 3: Test the relationship between the mediating variables and the dependent variables. Run 16 regression equations, with each mediating variable on each dependent variable. Use Model 1 landowner type as a control variable in each equation.

Table 17: Model 1. Regression Coefficients and Significance Levels for Mediating Variables on Knowledge and Interest in Agroforestry

	NON AGUSE		**PER: OBST**		**PER: ECON**		**PER: AMNTY**	
	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.	Coef.	Sig.
Knowledge in Agroforestry								
KNOW: ECON	.128	.008	.016	.391	.106	.002	.090	.008
KNOW: CONSRV	.165	.009	.011	.653	.242	.000	.223	.000

Interest in Agroforestry								
INT: ECON	.101	.013	.034	.027	.192	.000	.143	.000
INT: CONSRV	.165	.001	.003	.865	.251	.000	.231	.000

The table above shows that the mediating variables in Model 1 tend to have more predictive power on the dependent variables than landowner type. While their coefficients vary in size, non-agricultural land use (NONAGUSE), perceptions of the economic benefits of planting trees (PER: ECON) and perceptions of the amenity benefits of planting trees (PER: AMNTY) all show statistically significant predictive power. Interestingly, perceptions of the economic obstacles to planting trees is the only mediating variable that does not significantly predict knowledge or interest in agroforestry. The lone exception to that statement is the predictive power of the perceptions of economic obstacles to planting trees on interest in the economically-focused agroforestry practices, although the coefficient is small (.034) with a .027 significance level.

Figure 2. Model 1. Results of Mediation Analysis on Knowledge of Agroforestry Practices.

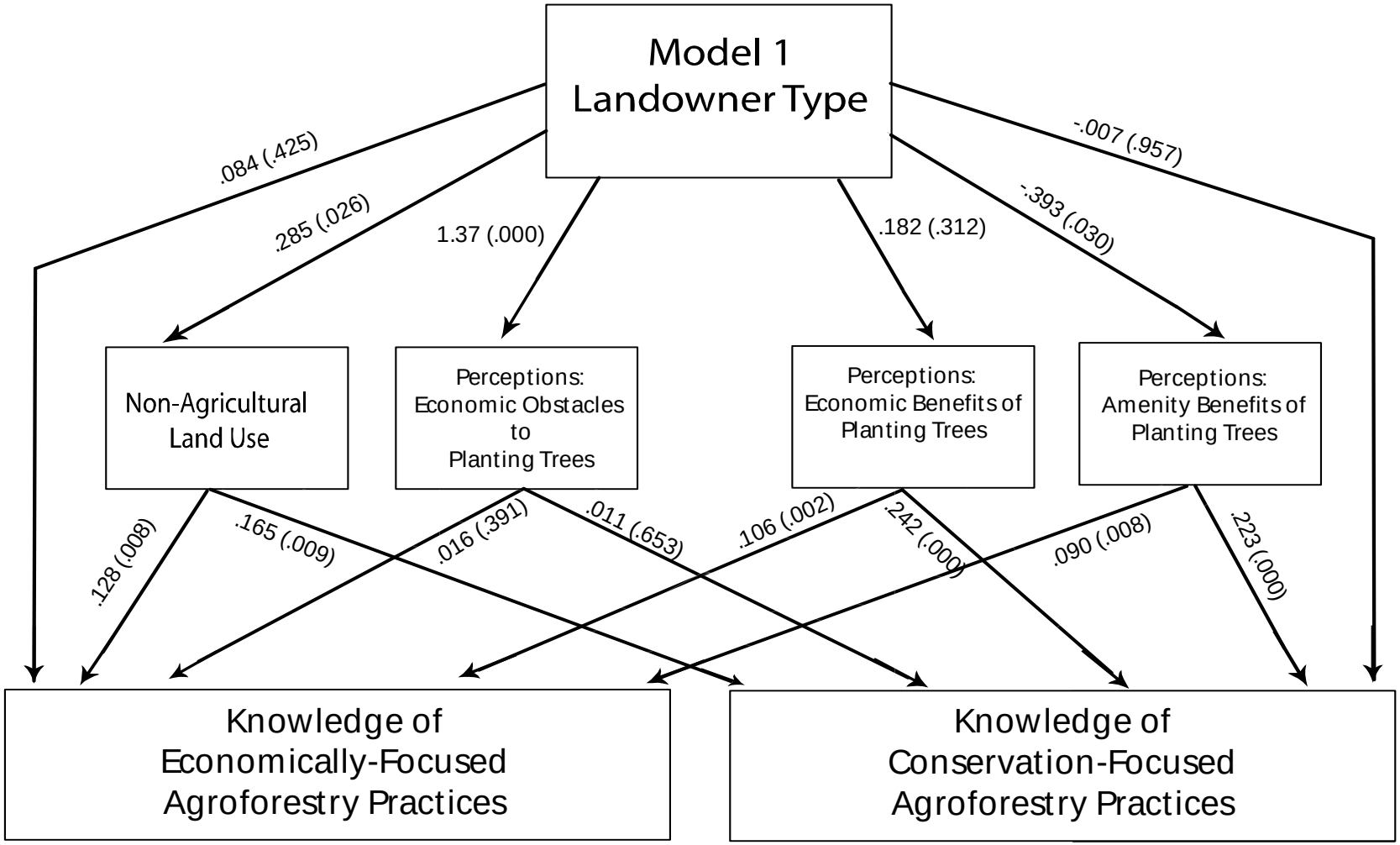


Figure 3. Model 1. Results of Mediation Analysis on Interest in Agroforestry Practices.