ADOPTION OF SUSTAINABLE FORESTRY PRACTICES BY NON-INDUSTRIAL PRIVATE FOREST OWNERS IN VIRGINIA

by

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Adoption of sustainable forestry practices by Non-Industrial Private Forest owners in Virginia.

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(ABSTRACT)

The concept of Sustainable Forest Management (SFM) has been promoted in the past few decades all over the world. Non-industrial private forest (NIPF) owners play an important role in that aspect in the U.S. because of their number (about 16 millions), the size of forest land under their control (about half of all forest land in the continental US), and the dynamism of their population (increasing number of new owners). This study sought to better understand how NIPF owners come to a decision for adoption (or non-adoption) of SFM practices. We developed a theoretical model combining four theories (the Value-Belief-Norm theory, the Theory of Planned Behavior, the Elaboration Likelihood Model, and the Innovation-Diffusion Process) to explain NIPF's decision making. Using multivariate analyses, we determined which elements of the developed theoretical model were significant in explaining adoption of eight groups of practices. Overall, some of the most significant predictors of adoption we identified were technical assistance, motivations for owning land and the use of a written management plan. Particular attention was also directed toward the eventual relationship between education and adoption of SFM practices and it was found that NIPF owners who attended educational programs tended to be likely adopters compared to those who did not attend any educational program. Since SFM was not limited to the US, we also analyzed the concept of SFM with the same goals as in the US, but under a completely different context (socio-cultural, economic and ecologic) in Africa, through the community-based natural resource management (CBNRM) system. We used four case studies and focused on criteria such as participation, equity (both procedural and distributive, power devolution, trust, etc) to analyze how CBNRM works on the field, what lessons to take from the cases to better ensure the goal of sustainability of the resources.

Table of Contents

List of Figures

List of Tables

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INTRODUCTION

General Concept of Adoption of Innovation Practices

Globally, trends to adopt and implement various SFM schemes have become increasingly common over the past decade, and non-timber forest goods and services have received increased attention from forest owners. The concept of SFM was rather new in the 1990s, and many SFM practices were considered innovative. The need quickly arose to transfer SFM concepts and practices to users such as practicing foresters and forest owners. In the United States, state cooperative Extension services were heavily used to transfer this technology. According to the widely used adoption theory of Rogers (2003), there are five major steps that an individual goes through when faced with an innovation. Phase one is knowledge, the phase in which one becomes aware (or extends his/her previous knowledge) about the innovation in general. Education represents a very important early part in this process because the rest of the adoption process depends on the quality and the personal relevance of knowledge delivered to clients. If the initial general information he/she gets is not relevant for him/her, the interest in seeking more information would be low. The second phase is persuasion, the phase in which one filters the information, picks what advantages and inconvenient he/she can get from trying new things given his/her economic, social, and cultural environment. This phase involves individual and social aspects because even if the innovation is desirable for the individual, if it is not socially acceptable, the individual is not likely going to adopt it: for example, in a society in which tree harvesting is not acceptable, even if an individual is interested in tapping the economic benefits from such a practice, if the family and/or neighbors are opposed, the individual would likely not opt for them. The third phase is decision, in which the individual, after having estimated the pros and cons of the innovation, makes a decision to either give it a try or not. The fourth phase is implementation, the phase in which the person tries the innovation. Implementation is a trial, which can yield positive or negative outcomes. Finally, the fifth phase is adoption, which is the confirmation, reached only after some time, when the person, after having tried the innovation, becomes convinced that it will bring him/her at least some positive outcome. If the trial did not yield positive outcomes, the innovation is likely to be rejected.

Non-Industrial Private Forests

There are roughly 749 million acres of forested land in the United States, 48% of which is in non-industrial private ownership (Salmon et al. 2006). Non-industrial private forest (NIPF) lands are very important nationwide because of their extent, the number of owners, and the large array of environmental (recharge of ground water, watershed protection), social (recreation and aesthetics) and economic benefits (timber products and other goods) they provide.

Different types of landowners can be called non-industrial private forest landowners; their common denominator is that none of them are part of the timber industry. Though NIPF owners also include private individuals, groups of individuals, tribes, partnerships and corporations not involved in wood processing, the majority of NIPF owners are families, including individuals, married couples, and other groups of individuals who are not incorporated or otherwise associated as a legal entity (Butler and Leatherberry, 2004). Nationwide, there are about 16 million NIPF owners controlling about 58% of the nation's forestland (Egan and Jones, 1993), and these NIPF owners have diverse interests, such as timber, water quality, privacy, recreation, etc.

In the South, forestland is one of the major land uses and the rural economy is dependent on forest resources (Measells et al., 2005; Hubbard, 1999). Measells et al. (2005) estimated the employment in the wood sector in the south exceeds 770,000 jobs and about $120 billion in total industry output. Other studies found that NIPF lands account for 70% of the commercial timber land and 69% of the total growing stock in the south (Kluender and Walkingstick, 2000). These opportunities and benefits are thought to be related to several factors including the highly productive nature of the forests, the type of ownership with more than 4.3 million NIPF owners, diverse timber markets, and other alternative land uses such as agroforestry (Butler and Leatherberry, 2004). In Virginia, NIPF owners own an estimated 77% of Virginia's 15.4 million acres of forest land (Shaffer, 1997).

Extension and Outreach

The forestry profession exists to ensure forest resource quality and sustainability. Extension is part of that forestry profession and its main purpose is to provide support for NIPF owners in order for them to reach their personal objectives for managing their land. The main goal of Extension is to enable and empower clients (people outside the scientific community that

need the innovation) in their own context and life situations by providing access to information and tools necessary for them to make decisions and to reach their own objectives (Boone, 1990). NIPF owners need the knowledge to make informed decisions to maximize the benefits they value on their property, even if their decision is to do nothing (Salmon et al., 2006). Providing forestry education and assistance to NIPF owners has always been considered one of the most effective ways to encourage active forest management (Bliss and Martin, 1990; English et al., 1997), along with technical assistance and financial assistance. Even after clients make decisions for adopting active forest management, Extension continues to provide help to assure accurate use of the knowledge in the field. Extension offers opportunities for clients to see the merits of scientific information, new technologies, practices and approaches (Hollstedt, 2001).

Research Justification

As mentioned earlier, the link between the field of research and NIPF owners is Extension, which provides NIPF owners with support for achieving their goals for their forest land. The support is mainly educational and/or technical. Educational support provided by extension services is essentially non-formal, i.e., outside of traditional schooling, non-hierarchical, and the content adapted to the needs of the "clients" in order to maximize learning (Etling, 1993). The main goal of those educational programs is to bring the results of research to people who are most likely to use it and on whom the success of the research in question depends. Research results, most of the time, come along with suggestions and recommendations on how to handle a given subject, field or situation. In forestry and forest management in general, recent research results tend to promote a balance between benefits and costs considering at least three dimensions (economic, ecologic, and social; cultural, spiritual, etc. can also be added). The trend is then no longer for the sake of the highest economic benefits to the detriment of any other dimensions. In other words, quite often, the message transferred by Extension services to forest owners suggests behavioral change in their way of managing their forest.

In our specific research, the behavioral change expected is the adoption of SFM practices recommended through various sources of information, including educational programs provided by various actors. It was not always known whether those information, suggestions and recommendations actually translated into NIPF owners' change in behavior on the field or not; and if they actually translated into behavioral change, it's not known to what degree and what

other factors were contributing in parallel to the behavioral change in question. It is also not known how much of the change in behavior is explained by those educational programs and technical assistance (which are the two main components that Extension service is working on for supporting NIPF owners).

The problem of the necessary behavioral change for a more sustainable forest management is not specific to the U.S.; it also applies to other parts of the world, including Africa where for the last few decades, new systems involving community-based natural resource management were promoted. With educational, technical and financial support, SFM provided local communities a way to better manage their forest. In some cases, the new system achieved its goal, in others, it did not. Are the factors that determined the success of community forestry the same as the ones determining the adoption of SFM in Virginia? Answering those questions is one goal of this study.

Research Objectives

The ultimate objective of this research was to better understand how NIPF owners come to a decision in favor (or not in favor) of adoption of SFM-related behaviors. For reaching that overall goal, we had sub-objectives in this research: the first sub-objective was to develop a model for predicting the adoption of active forest management practices (making informed decisions) by NIPF owners in Virginia on their land from these factors. The practices in question were related to woodland management options, wildlife management options, and timber harvesting and marketing. Emphasis was particularly put on the relationship between educational programs and the practices implemented on the land and we expected educational programs to show as a significant predictor of adoption of practices. Since we did not conduct field visits of the owners we surveyed to crosscheck whether there were differences between what was reported in the survey and what was actually implemented on the land. Thus, for this research, it was assumed that if a respondent stated he/she implemented a practice on his/her land, it was our research assumed practices were actually implemented.

The second sub-objective was to determine how important educational programs were in predicting NIPF owners' adoption of SFM on their land compared to other significant predictors. The study focuses on the outcomes of any program (or the lack of programs) offered to NIPF owners rather than on the process (how the program was delivered). This determination of the

significant factors that lead landowners to adopt SFM practices, as well as their respective importance in predicting the adoption of practices constitutes the first part of this dissertation.

Given the fact that there were diverse educational programs offered to NIPF owners, we analyzed one particular educational program, the Virginia Forest Landowner Educational Program (VFLEP), and determine whether it contributed significantly to a better rate of adoption of practices by NIPF owners on their land or not. That analysis is described in the second part of this dissertation.

The third part is about analyzing Community-based natural resources management in Africa, and then identifying the conditions that are likely to lead to its success (i.e., better and more sustainable management of the forests).

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ARTICLE 1: ADOPTION OF SUSTAINABLE FORESTRY PRACTICES BY NON-INDUSTRIAL PRIVATE FOREST OWNERS

(Abstract)

Non-industrial private forest owners (NIPF owners) own the majority of forest land in the United States; for that reason, they play a major role in the sustainable management of the forest resources nationwide, including the commonwealth of Virginia. However, the population of NIPF owners is a dynamic population, and it is not well understood what factors come into play to shape today's NIPF owners' decision to adopt or not adopt a suggested forestry practice. This first section of the study develops a model predicting the adoption of practices by owners from a proposed theoretical model (from the combination of four existing theories, including the value-belief-norm theory, the elaboration likelihood model, the theory of planned behavior, and the innovation-diffusion process), using multivariate statistical techniques. The relative contribution of technical assistance, financial assistance, and educational programs to the adoption of a given practice is also analyzed in this paper. Several models were developed, each related to a given set of management practices. The developed models correctly predicted between 69% and 97% of the classification of the cases from the holdout sample, used to validate the models. Also, the predictors retained in the developed models accounted for the explanation of 7% to 41% of the variance in the likelihood of adoption of a given group of practices. Some predictors of interest include technical assistance, which was among the strongest predictors, and "educational programs" and "acreage owned", which were not as strong predictors as expected.

Keywords: Non-industrial private forest owners, NIPF, sustainable forest management, adoption, value-belief norm theory, elaboration likelihood model, theory of planned behavior, innovation-diffusion process, technical assistance, financial assistance, educational program.

Definition of Sustainable Forest Management and Overview of the Research

According to the Food and Agriculture Organization, Sustainable Forest Management (SFM) is defined as the "management of forests in a way and at a rate that balances economic benefits and preservation of forest health, diversity and functions for the present and for the future." Given that the ultimate goal of this research is to better understand how non-industrial private forest owners make decisions about adopting or not adopting SFM practices on their land, this first section of the research aims to determine whether any of the different variables included in our study help explain NIPF owners' adoption of SFM practices or not.

Theoretical Foundation of the Research

Decision-Making Process for Non-Industrial Private Forest Owners

Predicting human behavior and understanding the mechanisms that trigger behavior at a given time, in a given situation, have always been subjects of interest for scientists. A number of researchers previously tried to determine the mechanisms underlying people's decision-making process, and use those mechanisms to predict human behavior. Several models were proposed to explain and/or predict behavior based on various internal and external factors. These models include Stern's Value-Belief-Norm Theory (VBN), Roger's Innovation-Diffusion Process, Ajzen's Theory of Planned Behavior (TPB), and Petty's Elaboration Likelihood Model (ELM).

This section provides a brief overview of these models and theories as a background for understanding and predicting Non-Industrial Private Forest (NIPF) owners' behavior toward adoption of sustainable forestry practices.

Value-Belief-Norm Theory

Derived from Schwartz's "moral norm activation" theory of altruism (Schwartz, 1977), the VBN theory states that a person's given behavior is function of three factors (Stern et al., 1999):

- One's worldview or perception of how the world is in general or about a specific object (which can also be a field, topic, ideology, etc.). This worldview is determined by the person's object-relevant values (e.g. all living species have the right to exist on earth, plants as well as animals).

- Depending on what this worldview is for a person toward the object, it leads to one's awareness of the consequences of an eventual behavior that might impact that object; if the object is valued, then one is more likely to engage in a behavior that will protect that object, or at least not to harm it, and less likely to engage in a behavior that might threaten or disadvantage that object (e.g. cutting forests without replanting will harm the environment).

- The last factor on which the VBN theory is based is closely related to the second because one's awareness of the consequences of a behavior triggers (3) one's self-ascribed responsibility to act. This self-ascribed responsibility to act then leads to an attitude related to one's sense of obligation to act, called moral norms or personal norms (Figure 1).

The VBN theory is a value-centered and moral norms-based theory; previous researchers found that the VBN theory was a relatively good model for predicting one's behavior because it could explain 19 to 35% of the variance in behavior (Kaiser et al., 2005; Stern et al., 1999).

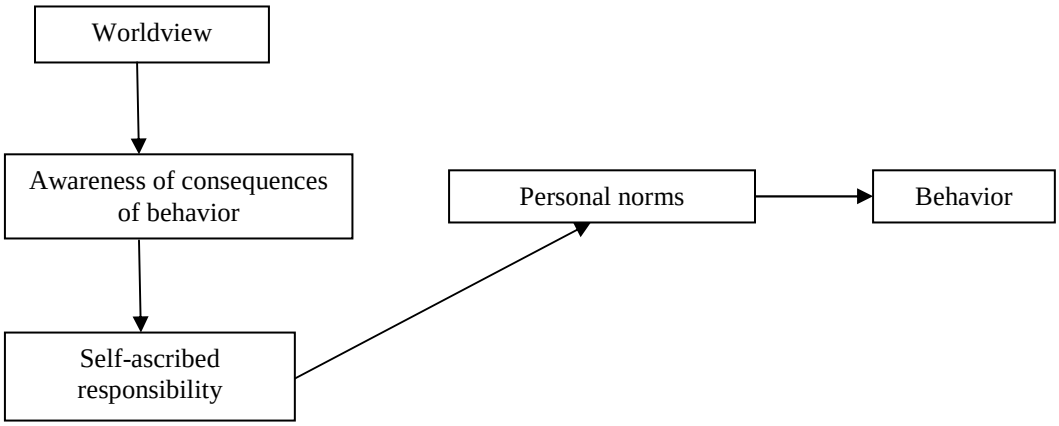

Figure 1. Value-Belief Norm Theory.

Innovation-Diffusion Process

In his theory of the Innovation-Diffusion Process, Rogers (2003) explains and describes that a person exposed to a new innovation passes through five steps before reaching the adopting phase of that given innovation. The five steps are (1) knowledge, which consists of the exposure of an individual to something new (innovation) followed by his/her understanding how the innovation functions and how it can be applied. Knowledge can be described as the part of the information filtered through cognitive processing by an individual and retained for present and/or future use. This first step is based on the premise that one needs an appropriate level of

knowledge about a given subject (object, behavior, topic, etc.) in order to adequately balance the pros and cons of that specific subject before making a final decision about what behavior to adopt and for how long.

After having acquired essential knowledge about a subject, the individual enters the persuasion phase, which involves mechanisms that influence the formation of an individual's attitude toward the innovation in question. It is during this step that the individual conducts the cost-benefit analysis (in every aspect: ecologically, economically, morally, socially, spiritually, etc.) associated with adopting an innovation. The persuasion phase depends greatly on what knowledge the individual had; if the person lacks knowledge about the benefits of a given behavior, his/her decision would mislead his/her cost/benefit analysis toward non-adoption; and if the person lacks knowledge about the negative aspects of a given behavior, his/her decision would mislead his/her cost/benefit analysis toward adoption.

No matter what the outcome from the persuasion phase is, the individual next passes through the decision phase, where he/she chooses to accept or reject the innovation. This step requires a combination of the knowledge and persuasion phases, and leads the individual's attitude formation by developing a plan of action (in case the outcome from the persuasion phase was favorable to the innovation). If the decision is to accept the innovation, the next step is implementation, which consists of the individual following through with his/her choice to engage in some behavior toward implementing it.

After having tried the behavior in favor of the innovation, the individual's last step is (5) confirmation, in which he/she realizes the benefits from undertaking the behavior related to the innovation offset the costs, and the individual then is seeking to reinforce his/her decision. If the implementation phase did not bring the expected benefits and the individual estimates that the benefits are not offsetting the costs, or they are relatively too marginal, then the behavior is likely to be abandoned, thus, the innovation would likely be rejected (Figure 2).

The perspective of diffusion of innovation emphasizes that expert sources of communications are mediated by the network social relations in a community that filter and reinterpret targeted communications (West et al., 1988). Actually, it is important to note that rejection can take place anytime and at any point during these five steps.

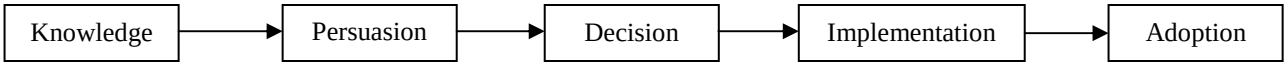

Figure 2. Innovation-Diffusion Process.

Theory of Planned Behavior

The Theory of Planned Behavior (TPB) of Ajzen (1991) was derived from the combination of two theories: the Theory of Reasoned Action (TRA) that predicted behavior from attitude and subjective norms and Self-Efficacy Theory (SET) predicting behavior from self-efficacy (the conviction that one can execute a given behavior required to produce a certain outcome) and outcome expectancy (related to an individual's estimation that a behavior will lead to a given outcome). The result of the combination of those two theories resulted in the TPB, which is based on three factors: (1) attitude, which reflects the subjective utility of a given behavior; it refers to the degree of approval or non-approval of a behavior by the individual; (2) subjective norms, a social factor referring to the strength of normative beliefs and motivations to comply with those beliefs; in other words, the perceived social pressure to perform or not to perform the behavior; and (3) the perceived control over a given behavior, referring to the perceived ease (or difficulty) to perform the behavior, so obviously it varies across situations. Those three main factors determine the individual's behavioral intention, which is the best predictor of an individual's behavior (Figure 3).

Previous studies showed that TPB explained between 25 to 30% of the variance in behavior (Ajzen, 1991).

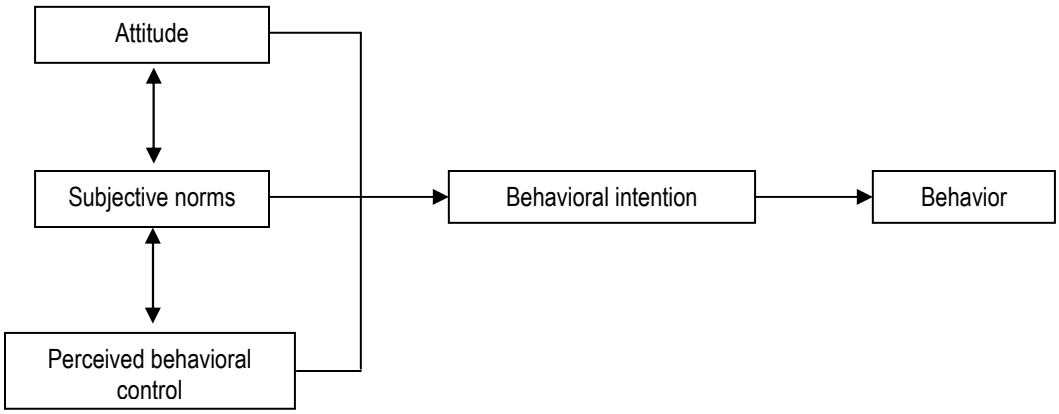

Figure 3. Theory of Planned Behavior.

Elaboration Likelihood Model

The Elaboration Likelihood Model (ELM) was developed mainly to analyze the mechanism that triggers people's behavior when faced with persuasive communication about a given subject. The ELM theory postulates there are two main moderator variables that an individual must have for adequately processing cognitively the persuasive message he/she is exposed to: motivation and then the capacity to process (Petty, 1995). Motivation depends greatly on personal relevance, which includes the individual's interest in the delivered message, the credibility and the trust of the individual in the person or the organization that delivers the message, the individual's personal responsibility, etc. The capacity to process depends on the situation at the time the message is delivered. A multitude of factors can intervene, including prior knowledge about the message content, distractions, message comprehensibility, etc.

According to ELM, every human being has an initial attitude toward a given subject/topic but what makes people different is in regards to those two factors mentioned in the previous paragraph. In ELM, on the presence/absence of those two moderator variables depends the nature of the individual's cognitive process: if at least one of those two factors are missing (no motivation and/or no capacity to process), then the individual will follow the peripheral route of cognitive processing, which requires low elaboration, meaning that the individual will deploy the least effort possible to analyze the situation. When such a case happens, the individual will not analyze the core of the message but rather will make a decision based on relatively superficial points (e.g., will analyze the number of arguments presented instead of their importance). This peripheral route results in the individual retaining his/her initial attitude. On the contrary, if both factors are present (i.e., the individual finds personal relevance in the message delivered and is also capable of processing), then he/she will follow the central route, which requires higher cognitive processing (high elaboration). When an individual is engaging in a central route of cognitive processing, he/she starts from an initial attitude, and then analyzes the argument quality, the credibility and credentials of the message deliverer, etc. One of two scenarios can take place during the analysis. In the first case, neither favorable nor unfavorable thoughts predominate at the first phase of the central route cognitive processing; the central route will stop to favor the peripheral route. In the second case, if either favorable or unfavorable thoughts predominate, then there will be a cognitive structure change; the new cognitions are then stored

in the individual's memory and make the different responses (about the subject of the message) more salient than at the beginning (prior to when the message was delivered). This fact ultimately results in a "central attitude change" (compared to the initial attitude), whether it is positive or negative. Attitudes resulting from that central route are likely to be enduring, resistant, stable, and thus predictive of a person's behavior (Figure 4).

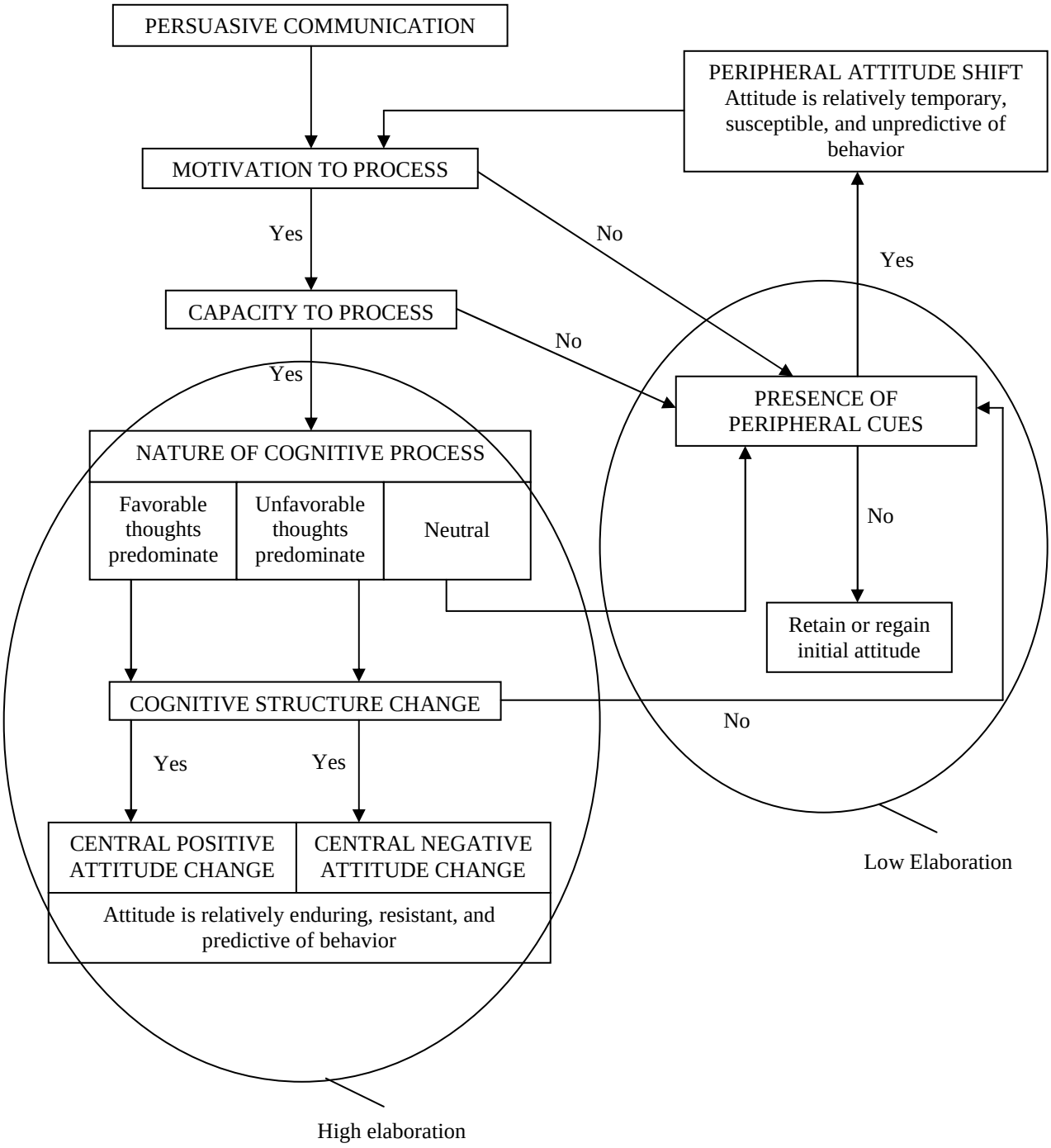

Figure 4. Elaboration Likelihood Model (Petty, 1995).

Relevance and Application of the Four Theories of Behavior Adoption

The ultimate objective of this research is to predict NIPF owners' behavior toward adoption of sustainable forestry practices (SFM). Many factors, external as well as internal to the individual, have to be considered for that aim, but a central piece in understanding the process resulting in any kind of behavior would be to understand what comes into play in the decision-making process for NIPF owners. In forestry, adoption of SFM practices is inevitably somewhat linked to a long-term prospect, thus, in this research; we are more interested in stable behavior, which means behavior that lasts, not just influenced by ephemeral opportunities and/or benefits. Measuring this stable behavior is not part of this study though, because that would require techniques such as longitudinal or cross-sectional studies. We assumed that behavior would be stable as long as it was processed cognitively using the central route. All four theories presented here deal essentially with the decision-making process, resulting in the undertaken behavior. All four theories focus on explaining the mechanisms underlying behavior formation within an individual, though they all have different approaches.

The Innovation-Decision Process of Rogers (2003), for example, provides the different phases one has to go through before implementing a given behavior, it is the model that best provides the framework and the notion of progress over time, and suggests that adopting a behavior can sometimes take time, especially when a long-term prospect, such as SFM practices is under consideration. Furthermore, it is the model that was suited for and has been used extensively in the Extension field and has always proven its worthiness. The other three theories can be applied to any kind of behavior and the whole process can take place in a very short time, so none of them address specifically the time dimension.

The VBN theory is interesting because it is a value-centered and norms-based theory, putting more emphasis on personal, social and moral values to predicting behavior instead of the traditional economic and environmental factors taken into account over and over in forestry-related research. The inclusion of those factors to predict behavior would bring another perspective to the field. The only problem with the VBN theory is that it was almost exclusively used in the field of pure environmental conservation, thus, its application and predictive power is not known when used in other fields.

The TPB is one of the theories that were widely used across fields and disciplines, it has common elements with VBN, and especially the importance of the social component (subjective

norms), but it also brings two very important individual element, which is the perceived control over a behavior and the actual behavior control; those aspects were not extensively used to explain people's behavior in forestry.

The ELM theory is interesting for this research because it is the theory that explains in detail what goes inside one's mind when processing given information. One of our main expectations for this research was that educational programs offered to NIPF owners would lead them to change their behavior toward making informed decisions about forest land management; in other words, educational programs were expected to be persuasive enough for people to adopt the central route and form a stable attitude favorable to the suggested behaviors (practices).

Given those points, we can say that the four models are complementary. We decided to develop our own model, taking into account elements from the individual theories together and we expect their combination to bring more predictive power of NIPF owners' behavior compared to that of the individual theories used alone. Our Proposed model is shown in Figure 5.

The Proposed model is an innovation-decision process with five phases. Any source of information (including educational programs) is a form of persuasive communication to which the person is exposed, and he/she cognitively processes (ELM model). Information and education comprises the knowledge box in the knowledge phase, resulting in a different level of understanding. The second phase (persuasion) consists of confronting the result of the individual's cognitive processing to the social and moral norms; along with the individual's evaluation of the difficulty (or ease) of performing the behavior in question. In other words, this phase includes the main elements of both TPB and VBN. The decision phase is next, with the formation of the individual's attitude toward a given behavior. A behavioral attitude can be supportive or go against a given behavior. The fourth phase is about implementing or not implementing the behavior itself, it depends greatly on the persuasion phase; a given behavior can be implemented or not depending on what behavioral attitude was adopted. The fifth phase goes beyond the act of implementing the behavior; the individual's cognitive structure changes to favor the behavior, so that the behavior would be relatively enduring and stable over time; this last phase is the true adoption per se.

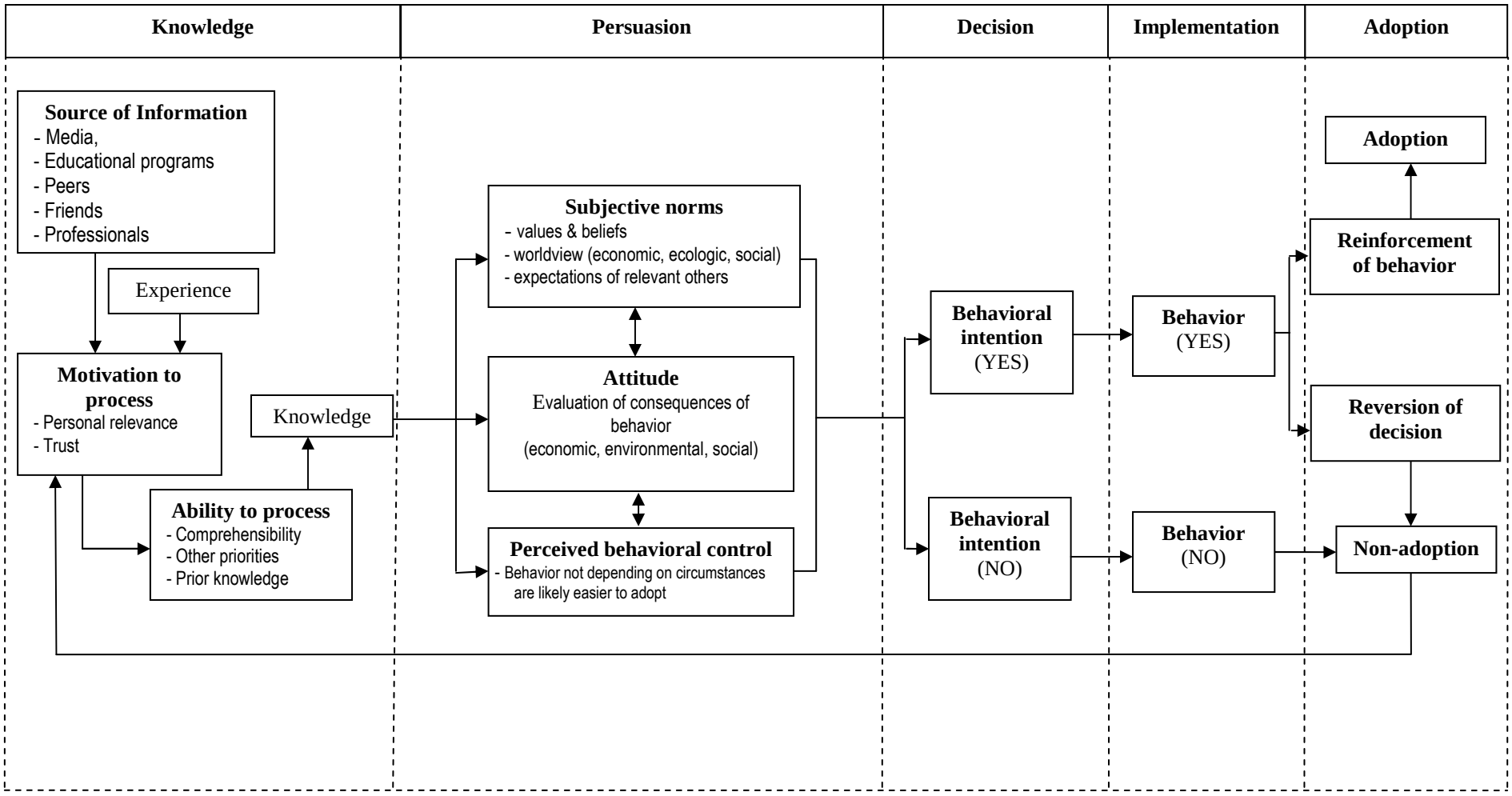

Figure 5. Proposed model of decision-making process for behavior adoption.

Non-Industrial Private Forest Owners

Characteristics and Dynamics of Non-Industrial Private Forest Owners

Previous studies found similarities between agricultural crops and forest systems: forested systems are changing constantly; however, the changes are not as fast as with other systems such as agricultural crops (Downing and Finley, 2005). In the last three decades, the number of NIPF owners generally increased. Kuhns et al. (1998), for example, found that there was an increase of 28% in the number of NIPF owners in the United States, and their number went from some 7.8 million to 9.9 million between 1978 and 1994. Butler and Leatherberry (2004) confirmed that trend by stating that the increase in the number of NIPF owners went from 9.3 million to 10.3 million between 1993 and 2003. Downing and Finley (2005), in their study about identifying what NIPF owners want in educational programs, found that there were 40,000 new NIPF owners every year in the state of Pennsylvania.

Given that some forest lands are increasing due to aforestation and/or natural growth, and some are decreasing due to factors like urbanization, the first and logical consequence of this increase in the number of NIPF owners is the decrease in the acreage that every owner owns (Kittredge, 2004). The nationwide fragmentation of NIPF lands appears to be accelerating, with more owners having smaller and smaller tracts of land (Best, 2002). Ninety five percent of NIPF owners in the United States own less than 100 acres of forest land, and 60% of them own less than 10 acres (Kuhns et al., 1998). The increased fragmentation of NIPF lands was coupled with a relatively short tenure, leading to a less and less likely intent to manage the land in a sustainable manner (Birch, 1996).

A number of studies have focused on identifying the characteristics of NIPF owners. Though there are differences in the results of those studies, they have several common points:

- From a demographic perspective, NIPF owners are different from the average American public. They have a higher level of formal education compared to the general population. They are older than the general population (retirees constitute about 33% of all NIPF owners nationwide, followed by professional workers 20% and farmers 10%). They tend to be more affluent than the average American. In terms of ownership size, about 75-80% of them own less than 50 acres of land; the averages estimated from the responses collected seem misleading since those who own more than 50 acres control 69% of the NIPF land, and account for only

11% of the number of owners (Butler and Leatherberry, 2004; Kittredge, 2004; Measells et al., 2005, Kuhns, 1998; Jones et al., 1995).

- From a management perspective, many studies show that very few NIPF owners use a management plan. Several studies found that there was a very low level of interest in planning and using a management plan; for example, only 11% of NIPF survey respondents had a written management plan (Measells et al., 2005), 5% (Birch, 1996), and 3% (Butler and Leatherberry, 2004). These surveys showed, however that 16% sought management advice in general, and 22% sought professional advice during the most recent harvest. This suggests that NIPF owners do not necessarily consider the need for having a written document for managing their forest land. The more land an owner has, the more likely that he/she has a written management plan, whether the goal is timber production or not (Best, 2004).

- Though timber production is no longer as important as it was several decades earlier as a reason for owning forest land, an important proportion of NIPF owners have harvested timber at some point during the time they owned forest land. The U.S. Forest Service's National Woodland Owners Survey (NWOS) [http://ncrs.fs.fed.us/4801/national-programs/woodland-owners/] showed that owners who had harvested timber on their land control 71% of NIPF lands; 50% of owners have harvested trees at some point during their tenure, and 26% of them harvested for reasons other than just firewood. The prevailing harvesting practice, in the hardwood forests of the eastern U.S. is high grading, a non-sustainable forestry practice (Nyland, 1992).

Consequences of the Increasing Number of Non-Industrial Private Forest Owners

Some of the changes that came along with the increased number of NIPF owners and the fragmentation of the forest land are (1) their reasons for owning forest land, (2) the diversification of the objectives and goals of those owners, and (3) what they intend to do with their land in the future.

- It was assumed in the past that owning forest land was synonymous with willingness to sell timber (Jones et al., 1995). Though the main reasons for owning forest land did not change significantly during the past few decades, their relative importance did. There is a clear increase in the importance of aesthetics and passing land to heirs (amenity values), and a

clear decrease in the importance of timber production (economic values). From the NWOS data between 1993 and 2003, the top reasons for NIPF owners for owning forest land were (1) having an estate to pass on to heirs (53%), (2) part of residence/farm (44%) and (3) privacy (41%). Measells et al. (2005) found that small landowners tend to give priority to amenity values and larger ones place greater values on commodity production. While those who primarily hold their land for timber production only constitute 9% of NIPF owners nationwide, they control quite a large proportion of land because they are usually owners of large tracts (Butler and Leatherberry, 2004).

Regional differences also exist when it comes to the proportion of NIPF owners considering timber production as a reason for owning forest land: 41% in the South compared to 22% in the North and 18% in the West. Those differences can be related to the fact that the different regions have different timber productivity rates and markets for forest products (Butler and Leatherberry, 2004).

- Another consequence of the increasing fragmentation of the parcel sizes is the diversification of objectives and goals of NIPF owners. Indeed, three factors are limiting the diversification of management options for private forest owners. First is the parcel size, smaller size holdings are less likely to be economically profitable due to the economy of scale. The second factor is the lack of markets for many forest products, discouraging owners from investing in their forest (Kilgore, 2004). Those two factors, added with the lack of awareness of NIPFs about other alternatives for use of their land, lead NIPF owners to have less diversified management options (Butler and Leatherberry, 2004).

- As a consequence of the changes in goals and objectives, it is not surprising that the majority of NIPF owners intend to do little management if at all on their land in the future: 10% are just keeping their land to pass to their heirs, 5% are planning to sell their land, and only 8% are planning to acquire more forest land (Egan and Luloff, 2000). When asked about their future actions, the majority of NIPF owners chose the status quo, or just nominal actions in the next five years (Kittredge, 2004).

Factors Influencing the Decision-Making Process of Non-Industrial Private Forest Owners

Several factors influence the decision-making process of NIPF owners. The economic factor is one of the most important ones. Indeed, the per-acre cost of preparing a timber sale, harvesting, and regeneration increases as the size of the sale decreases, especially when it is below 50 acres. Also, the stumpage price tends to go down as harvest plots get smaller (Thorne and Sundquist, 2001). As stated earlier, the majority of NIPF lands are less than 50 acres, thus, many timber harvests on NIPF lands are likely to encounter that higher cost and lesser revenue. Both facts constitute a disincentive for timber production, and thus for active management. The increasingly smaller parcel size combined with the increasingly rapid turnover of ownership brings NIPF owners to seek professional help less in the planning and management of their land. Overall, active management of NIPF appears to be declining (Sampson, 2004). The increasing demand for rural land for development causes a big increase in the real estate value, and reduces the incentive to manage for natural resources. The economic appeal of development is often far more lucrative than other alternatives, such as keeping the land forested. On the other hand, with the increasing number of new landowners and the increasingly smaller size of land per owner, other recent studies suggest that the tendency for landowners is less in favor of economic motivations compared to more non-market motivations, such as privacy, aesthetics, biodiversity protection and that incentives conforming to these motivations are likely to lead landowners to actively manage their forest land (Hull et al., 2004).

Another factor that can influence NIPF owners greatly is knowledge**.** Several studies found that landowners could not maximize their forestland potential because of a lack of awareness and lack of knowledge of the different alternatives they could have used on their land. A low level of knowledge results in passive management (Salmon et al., 2006). Other factors include a lack of capital, and lack of technical assistance. All of these blocking factors could be solved if NIPF owners decided to participate more in educational opportunities that were offered to them, because they can improve their knowledge about managing their land, reduce expenses through cost-share programs, and implement sustainable forestry practices on their land, suited to their needs and objectives (Gan and Kolison, 1999).

All of these suggest some adjustment in the Extension and outreach approach in providing NIPF owners with what they need.

Implications for Extension and Outreach

The main purpose of Extension and outreach is to provide support for NIPF owners in order for them to be able to reach their own objectives by actively managing their forest land. Active management here means providing them with the ability to make informed decisions to maximize the benefits they value on their property, even if their decision is to do nothing (Salmon et al. 2006). For that, providing forestry education and assistance to NIPF owners is one of the most effective ways to encourage the active management of those people's lands (Bliss and Martin, 1990; English et al., 1997). But why are there so many NIPF owners who have never attended any educational program?

Diversity of Non-Industrial Private Forest Owners

The immediate consequence of the increasing number of NIPF owners is the higher diversity of NIPF owners. While diverse, they can be separated into more or less homogeneous segments. A number of studies have focused on segmentation of NIPF owners, using psychographic factors. Some recent studies segmented the NIPF owners' population according to their objectives (Kittredge, 2004). Kendra and Hull (2005) used motivations for owning land as the basis of the segmentation of the NIPF owner population in Virginia; Kline et al. (2000) used the reasons for owning forest land for NIPF owners in Oregon and western Washington; Kluender and Walkingstick (2000) used management intentions to segment NIPF owners in Arkansas; and Salmon et al. (2006) focused on the benefits that NIPF owners get from their forest land (benefit-based audience segmentation). Each of these studies came up with its own NIPF owner segments and identified the differences between each segment.

In the past, there was more emphasis by extension and outreach personel to target either NIPF owners owning large parcels (Kuhns et al. (1998) found that landowners with large acreages are more likely knowledgeable about forestry than those with smaller land) or to use averages as representative of all NIPF owner populations (Larson, 2004). Neither approach really targeted the majority segments of the NIPF owner population because that majority is neither large forest owners, nor average; rather, they are small owners. Indeed, over six million NIPFs own less than 10 acres (Larson, 2004). There is then a need to tailor outreach approaches and educational programs to the diverse groups of NIPF owners.

As a consequence, landowner assistance efforts should develop programs that suit a full range of NIPF owner objectives such as timber production, amenity values, etc. (Bliss et al. 1997; Kluender and Walkingstick, 2000). For instance, programs offering cost-share opportunities or technical assistance to increase production on NIPF lands are less likely to work if the NIPF owners do not have timber production objectives.

Segmentation of Owners Based on their Needs and Preference

Within the last decade, a number of studies focused on the segmentation of NIPF owner's population. The main rationale behind these segmentation studies consisted of focusing specific topics of outreach efforts on specific groups of NIPF owners as opposed to the older approach that considered NIPF owners as a whole group, and targeted only the most innovators groups of NIPF owners.

For instance, according to the benefit-based segmentation technique (detailed in Table 1 below), we can have three segments (amenity-focused, multiple-benefit, and passive) of NIPF owners (Salmon et al., 2006; DeCoster, 1998; Kline et al., 2000). Each segment differs from others in terms of needs and preferences about the mode of delivery of information about forest management. Multiple benefit segment people prefer receiving personal on site assistance from foresters while amenity-focused owners prefer printed materials and passive owners prefer online materials. Within each segment, there is also a difference between absentee owners and on-site owners: absentee owners prefer printed materials (newsletters, magazines, etc.) because they do not have much of a local social network, including contact with forestry experts. In contrast, people who are living on their forest land tend to prefer one-on-one interaction with professionals to printed or online materials (Downing and Finley, 2005).

Higher level of interactions between multiple-benefit landowners with local forestry experts is a result of the social and community networks that these landowners were part of, not because these landowners had actively sought out the information.

Over two-third of landowners from the amenity-focused and passive landowners live in a different county than their forest land, thus, they are isolated from the communities that surround their forest land (Table 1). Therefore, a suggestion and objective for outreach is to raise NIPF owners' awareness about compatibility of forest management and their goals.

For multiple-benefit owners, participation in social networks in the regions surrounding their land means that it is quite likely that personal assistance for a few key multiple-benefit owners could have far-reaching effects when the information they get is shared with neighbors and peers (West et al., 1988; Rogers, 2003).

Passive landowners are either disinterested in forestland ownership, or researchers failed to identify the aspects of ownership they value. More studies focusing on the segmentation of the NIPF population have also been conducted; the following section deals with this matter.

These three groups are analogous to other classifications including Butler et al.'s (2007) because all of them can be put on the profit-amenity continuum.

Table 1. Categories of NIPF owners according to their objectives.

		Amenity-focused	Multiple benefit	Passive
	Definition	Non-income generating benefits > income generating benefits importance	Income generating benefits = non-income generating benefits	All benefits considered unimportant
Landowner characteristics	Absenteeism	High	Low	High
Timber harvesting	Harvested timber	22%	31%	10%
	Income from timber = important	25%	85%	14%
	Active management of land	Hesitant	Higher motivation	Neutral
Sources of forestry information	Contact with foresters	Less likely	More likely	Less likely
	Most preferred sources of information	Printed or on-line materials (Brochures, booklets and fact sheets)	Personal on-site assistance from a forester	Internet

Segmentation of Owners Based on their Objectives, Concerns and Future Intentions

The analysis of the USDA Forest Service National Woodland Owner Survey (NWOS), allowed the segmentation of NIPF owners based on their objectives, concerns and intentions. The study was conducted by the Forest Service, the Yale program on Private Forests and Roper Public Affairs and Media (Roper Public Affairs and Media, 2007). Four segments were identified from the analysis, including woodland retreat owners, supplemental income owners, working the land owners, and ready to sell owners (uninvolved owners). *Woodland retreat* owners are motivated by the amenity values of their land, the land's beauty, wildlife and the privacy it provides them. Their motivations for ownership of the land are mainly emotional. This segment of owners is guided by motivations such as the love of the land (a very deep attachment to the amenity values of the land), or the land itself (owning the land is a value in itself), privacy,

providing them with freedom to do what they want to do on their land, without being worried about disturbing neighbors. Other motivations include things like recreation (hunting, fishing, hiking, etc); activities that promote family closeness. They constitute 40% of NIPF owners and control 30% of the land (Butler et al., 2007). *Working the land* owners own their land for both financial and amenity reasons; money is neither their unique nor main reason to own their land. They share many of the woodland retreat owners' motivations, including privacy, or beauty of the scenery; country life (instill more solid values to children, bringing the next generation to have wonderful memories to look back on, etc), and legacy. Inheriting land is most of the time synonymous with a strong sense of responsibility for the land. They constitute 22% of NIPF owners and control 25% of the land (Butler et al., 2007). *Supplemental income* owners own their land for financial reasons only; they are the least emotionally attached landowners. Their motivation includes making money on a possible sale of timber and/or land, or owning the land for its future value; earning principal or supplemental income (to live on, to pay taxes, etc.). They account for 15% of NIPF owners and control 22% of NIPF land (Butler et al., 2007). *Uninvolved* owners are usually absentee owners who are detached from their land. They are the oldest group of owners and are likely to be absentees. They account for 23% of NIPF owners and control 23% of the land.

In brief, the study concluded that woodland retreat and working the land owners share motivations and feelings, thus, an approach can be used to reach both. On the other hand, supplemental income and uninvolved owners seem to be very difficult to communicate with.

Segmentation of Owners Based on Attitudes toward Stewardship and Engagement in Land Management

Along with the analysis mentioned in the previous paragraph, the same institutions (the Forest Service, the Yale program on Private Forests, and Roper Public Affairs and Media) were conducting a prime prospect analysis of NIPF owners, based on attitudes toward stewardship and engagement in land management (Roper Public Affairs and Media, 2007). Four groups emerged: Model owners, Prime prospects, Potential defectors, and Write-offs. *Model owners* are very active, passionate and dedicated to good land management, eager to help others, whose advice are listened to by other owners, very knowledgeable about their land–leaders who are practicing SFM on their land. They account for 15% of NIPF owners and control 26% of the land (Butler et

al., 2007). *Prime prospects* also feel strongly about their land. They are not currently practicing good land stewardship, but are likely to because they are open to learning more about improving their land. They mainly differ from Model owners in that they think they are already practicing SFM on their land while they are not. They are also the most efficient group of people to influence. They account for 29% of NIPF owners and control 28% of the land (Butler et al., 2007) *Potential defectors* are currently having to some extent the desired behavior about managing land but they are losing interest because of various reasons, including obstacles. A distinctive attitude they have is also that they think they already know all they need to know about managing their land, thus, are less likely to be open to improve anything. They account for 44% of owners and control 37% of the land (Butler et al., 2007). *Write-off* owners are owners not performing any of the desired behavior and are not interested in doing so; they are not receptive to any outside input. This group is the most difficult to influence; they account for 13% of NIPF owners and control 9% of the land.

Opportunity Costs of Non-Industrial Private Forest Owners

Outreach efforts and policies to support and bring NIPF owners to actively manage their forest land did not necessarily take into account the opportunity costs of NIPF owners. Nowadays, pressure from development and other much more lucrative alternative land uses outweigh the active management of the forest land. It is necessary to make incentives worthwhile for the landowners. For instance, programs offering a few dollars of tax relief are not worth much compared to real estate market pricing forested land at several times its undeveloped value (Kilgore, 2004). Another example is the opportunity cost related to reduced timber harvests, owners should be provided realistic incentives for harvesting sustainably (Kline et al., 2000).

On the other hand, there is also a need to require landowners commitment in return for the benefits provided to them through public policies. For instance, Hibbard et al. (2003) found that out of 66 forest preferential property tax treatment programs, only 16 required the owner to obtain and use a management plan.

Underserved Non-Industrial Private Forest Owners

Underserved NIPF owners are defined as "those who had not obtained assistance from professionals, had not previously received information pertaining to forestry, had not belonged to a forestry related organization, and/or had not attended available forestry-related educational programs" (Measells et al., 2005). In the past, outreach efforts tended to target what Rogers (2003) called innovators and early adopters, as Butler et al. (2007) also stated. These two groups in fact represent a minority of the population of NIPF owners. The rationale was that once innovators and early adopters are targeted, they in turn will spread the knowledge to the rest of the population in a given area through a peer to peer knowledge transfer (West et al., 1988). Those landowners who did not follow the innovators and early adopters may not be interested because their objectives and/or reasons for owning lands were different from that of those who were targeted firsthand (Salmon et al., 2006).

Several studies found that underserved NIPF owners remained underserved because 34% of them were unaware of the services, 61% of underserved NIPF owners who did not attend any forestry related educational program, because they were unaware of their existence (Measells et al., 2005; Zhang et al., 1998). Also, 75% of them were not familiar with government cost-share programs, etc. "It is paramount that forestry professionals be proactive and flexible in educating NIPF owners by notifying them of available forestry-related resources" (Measells et al., 2005). By notifying NIPF owners of the available programs, landowners can attend them and thus become more knowledgeable about ways to actively manage their land and realize the full range of benefits from owning forest land.

Summary

The NIPF owner audience is a moving target, new owners enter the population while others leave, it is not a homogeneous population but has a wide variety of people in different dimensions such as objectives (non-consumptive and consumptive goals), demographics, benefits, etc. Also, as stated earlier, the ownership turnover is quicker than it was in the past and as a consequence, it is not always accurate to assume the average NIPF owner as being representative of the population (Rickenbach et al., 1998; Bliss et al., 1994). NIPF owners tend

not to give priority to written management plans due essentially to the fact that they were not aware of them or if they were, they did not think were worth the work.

In brief, many NIPF owners do not actively manage their land (i.e., did not adopt sustainable forestry practices) because of various reasons including some false assumptions and/ or approaches used in outreach programs in the past. These include:

- The assumption that timber production is necessarily part of owners' objectives and it was dominant compared to amenity values such as aesthetics or recreation.
- The assumption that the average NIPF owner was representative of the population of NIPF owners, and tailoring the educational programs to that particular target.
- The use of languages or approaches that owners interpreted to be a way of talking down to them, telling them what to do and not to on their land, threatening their control over the land (Roper Public Affairs and Media, 2007).

The result was generally a low adoption of the programs because they did not address the needs of the majority of the NIPF owners.

Given that the future of forests and sustainable delivery of public goods and services depend on NIPF owners who generally care about their land but are not always in position to make informed decisions. Therefore, outreach programs as well as incentive policies have to be adjusted to suit their needs by addressing the diversity of NIPF owners, especially the underserved ones, their needs and preferences, their opportunity costs, etc.

In conclusion, improving NIPF owners' knowledge about forestry and forest management will help them make more informed decisions related to the management of their land, which decisions will then lead to enhanced economic viability and an improved quality of life; however the approach and ways to provide them with that knowledge have to be suited to their needs, goals and objectives.

Methods

Objectives and Hypotheses

The research is based on determining the significant factors leading forest owners to adopt practices (behavior) that ensure sustainable management of the forests in question.

From the literature review, we developed the following main hypotheses for this study.

- The frequency of attendance of educational programs related to forestry practices would be among the significant independent variables explaining NIPF owners' behavior toward SFM practices.
- The more educational programs an individual had attended, the more likely he/she would be an adopter of SFM practices and vice versa.

The overall methodology employed in this research is depicted in Figure 6.

Sampling

The target population for this research is the population of NIPF owners in the state of Virginia. The study population includes NIPF owners who, at some point since 1997, manifested some interest to acquire information about active forest management. The common denominator for individuals in the study population is that they all were exposed to at least one possibility of engaging in active forest management, through a newsletter that informed them about available educational programs, as well as technical assistance and financial assistance. This study population includes some 24,000 individuals on the list but they did not all have the same reaction towards the services offered; instead, there were two distinct groups: one group consisted of landowners who decided to attend at least one of the educational programs offered, and the other group consisted of landowners who did not take any action beyond seeking information.

The database with the list of Virginia non-industrial private forest owners who were exposed to the possibility of attending the available educational programs was used to extract the sampling frame for this study.

Inclusion Criterion

All NIPF owners who own/owned two acres or more of forest land.

Exclusion Criteria

- All individuals in the database who are not actual private forest landowners or who owned land elsewhere than in Virginia.
- All individuals in the database who are not actual private forest landowners or who owned land elsewhere than in Virginia.
- All forest landowners on the list owning less than two acres of forest land.

After applying those criteria, we came up with a much more reduced list of 5,793 people in total; this shorter list constituted our sampling frame.

Sampling Design

Given the number of people in our sampling frame, we could not proceed with a census. Instead, we opted for a random sampling method that, with the resources we had, allowed us to use a sample of about 60% of the study population. The sample size then included 3,435 individuals.

Figure 6 presents a flow chart of the research process.

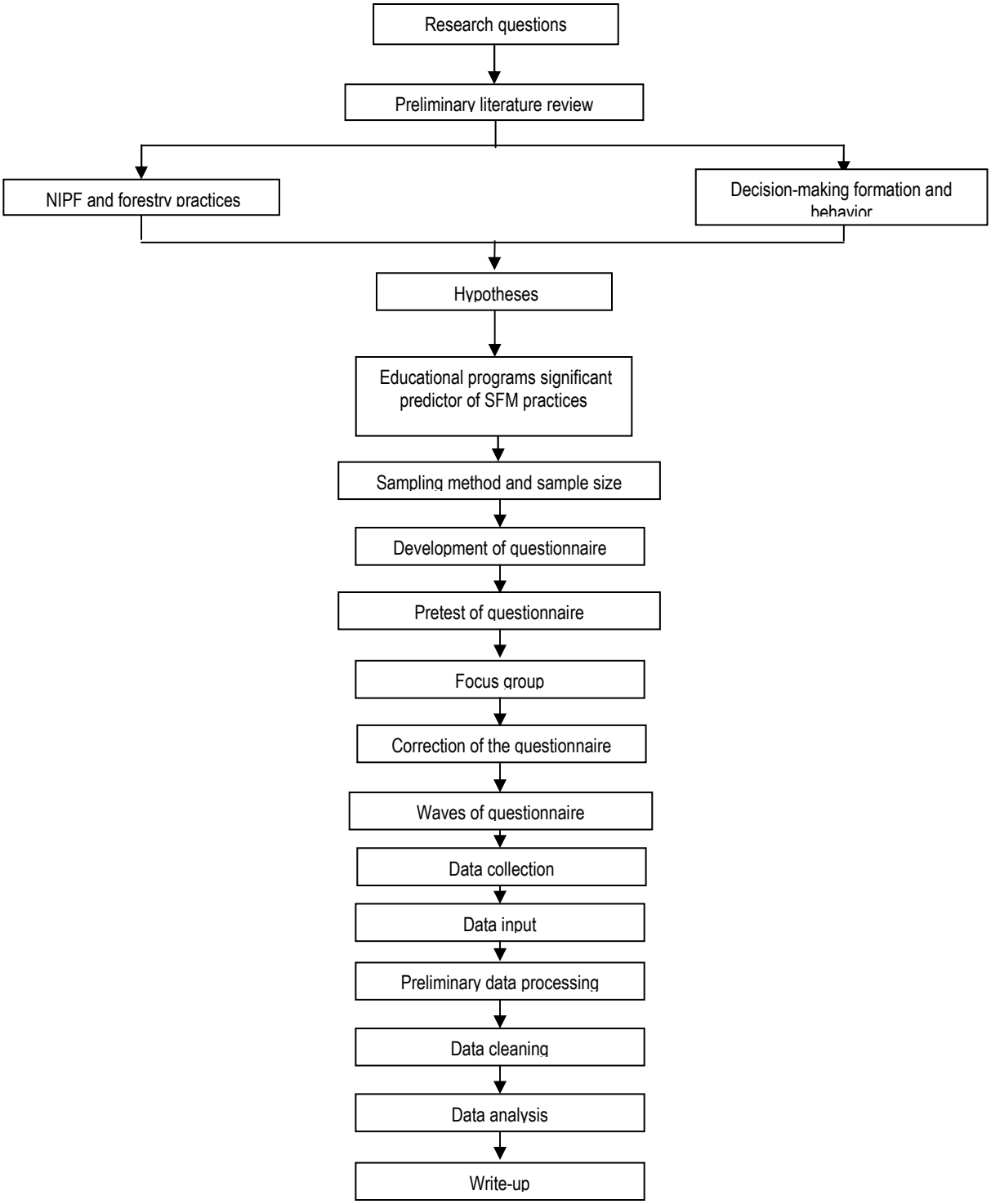

Figure 6. Overall methodology used during the research.

Types of responses

Each respondent either responded (response), did not (no response), or was not reached (undeliverable questionnaire).

Responses included the following:

- Fully or partially completed questionnaires mailed back to us,
- Blank questionnaires mailed back to us, apart from those that could not be delivered (wrong addresses),
- Respondents who contacted us by calling or sending us an e-mail to let us know about the questionnaire, whether they sent the questionnaire back or not,
- Respondents who sent a letter to us explaining why they did not mail the questionnaire back (and/or any other information related to the survey).

There were two types of responses: usable and non-usable.

Usable responses included:

- Fully or partially completed questionnaires that could be statistically analyzed. The rest of the analysis is based on usable responses.

Non-usable responses include:

- Blank questionnaires mailed back (with or without any explanation about why the questionnaire was left blank).
- Questionnaires from respondents who did not own any forest land in Virginia at any time in the past ten years but filled the questionnaire out.
- Questionnaires with only the demographics section completed.
- Information from respondents, who just called, e-mailed or sent letters to us explaining why they did not return the questionnaire without sending a completed questionnaire back.

No response category:

This category included all respondents who did not belong to any of the two preceding categories:

- Respondents whose intended questionnaire was lost in the mail for some reason,

- Respondents who got the questionnaire but did not return it and did not tell us why they had not done so, or returned it but it got lost in the mail.

Undeliverable (wrong addresses)

- This category includes questionnaires that could not be delivered to the addressee and were returned to us. They were not included in the response rate calculation.

Pretest of the Questionnaire and Mode of Administration

For validity purposes, the questionnaire was pilot tested; it was mailed to 120 NIPF owners using a slightly modified version of the Dillman's (2000) tailored design method, using an advance letter that alerted them about the survey, followed by the survey package (cover letter, questionnaire, self-addressed stamped return envelope) a week later. For practical reasons, we decided to conduct the pilot test with forest owners living in Montgomery County, Virginia (the towns of Blacksburg and Christiansburg). A summary of the results of the pilot test of the questionnaire is in Appendix C.

Focus Group

After all responses from the pilot test were gathered, a focus group was held to ensure the validity of the questions (i.e., to make sure all questions were clear and understood the way we intended them to be). Respondents made comments, provided suggestions about unclear questions we identified from the pilot test results and that other respondents themselves did not understand or interpreted differently. The focus group was also used to get input from respondents about the presentation of the survey (length, format, wording of questions, font size, etc.). Given the very limited number of respondents who could come to the focus group session (only two voluntary NIPF owners came out of 33 invited), the format was more of a discussion on the points that respondents and ourselves considered important. The materials used during the focus group are presented in Appendix D.

Data Collection

The survey was mailed after analysis of the pilot test, and correction and revision after the focus group. It was administered using a modified version of the Dillman's tailored design method (Dillman, 2000) by using two waves of mailings of the survey packet (advance letter, cover letter, questionnaire, self-addressed stamped return envelope), and a wave of reminder cards.

The first mailing was in late April 2007. A month later, the reminder card was sent to all recipients who did not return the questionnaire. We waited for another month before sending out the second wave of mailing of the survey packet, and asked recipients to return the questionnaire even if they did not fill it out, with a mention of the reason why it was not filled out in order for us to know that they did not fill the questionnaire out purposefully, not because they lost it or for other reasons.

Data Input, Preliminary Data Processing and Data Cleaning

In parallel with the data collection, we entered the data on an Excel spreadsheet, then, conducted preliminary data processing using the Statistical Package for the Social Sciences (SPSS) to identify and fix any problems or mistakes made during the data entry. It was only after the data was cleaned that we proceeded to the actual data analysis.

Data Analysis

We used both descriptive and inferential statistics to analyze the data. A model for predicting the adoption of active forest management practices by respondents was developed. There are eight groups of practices that we considered for this matter: harvesting practices, wildlife management practices, woodland management practices, best management practices (BMPs), conservation easements, management plan, technical assistance (professional help), and financial assistance (cost-share programs). Each of those groups of practices includes a number of individual practices, and we defined the NIPF owner as adopter if he/she adopted at least one of the individual practices within a group of practices. A ninth group of practices is the combination of the eight listed above, it is called "all practices".

The data analysis required two multivariate statistical analyses; first was data reduction through factor analysis, and second was a logistic regression analysis to determine what variables were significant in predicting the likelihood of a person to adopt a given practice.

Factor Analysis

Variables that were reduced through factor analysis include "Reasons for owning forest land" (or motivations), "Sources of information used to make management decisions", or "Limiting factors for active forest management" perceived by the respondents.

We are interested in grouping variables, not cases, thus, R-type factor analysis is more appropriate to use and given that our goal is to summarize the original information from the raw list of variables into a minimum number of factors for prediction purposes, the principal component analysis (PCA) was the chosen technique.

Requirements

Two points are to be considered to check if our data meet the requirements and appropriateness of factor analysis or not before getting deeper into the analysis.

- First is the correlation matrix for all the variables in the analysis. A visual inspection ensured that there were enough significant correlations among the variables. Both the number of correlations equal or greater than 0.3, and the significance of the correlations are taken into account here (Hair et al., 1998). The Bartlett test of sphericity tests for the presence of non-zero correlations among at least two of the set of raw variables.
- The second is the measure of sampling adequacy (MSA), used to quantify the degree of intercorrelations among the raw variables. A higher value of the MSA means that there is a high degree of correlation between the variables (i.e., factor analysis is appropriate). MSA values range from 0 to 1 with 1 meaning perfect prediction of each variable by others without error; 0.80 meaning meritorious prediction; 0.70 meaning middling prediction; 0.60 meaning mediocre prediction, and 0.50 or less meaning miserable prediction (Hair et al., 1998). We chose the cutoff point of 0.80 for our analysis.

Factor Matrix

After verifying the appropriateness of the use of factor analysis, the next step was to compute communalities. Communalities are the estimated amount of variance shared among all variables in the analysis and on which derivation of the factors from the factor analysis is based. Variables having communalities less than 0.3 were excluded from further analysis, the rest were retained.

Our data involved multiple groups using the same scale with different variances (as opposed to variables with different scales); for that reason, the appropriate extraction technique used was covariance matrix. The number of factors extracted was determined using the latent root criterion (any individual factor should account for the variance of at least a single variable if it is to be retained for interpretation).

Given that our goal was to summarize the original information contained in the original set of variables to the least possible number of independent, uncorrelated factors, orthogonal rotation of the factors would simplify the factor structure using the orthogonal method. The rotation method used was Varimax, because it provides as many orthogonal factors as possible by simplifying the columns in the factor matrix (i.e., makes as many values as possible in each column close to zero).

When the factors were rotated, we analyzed the factor loading for each variable (the correlation between that variable and the factor; a high factor loading suggests a high variance of that variable accounted by the factor). As a criterion of significance suggested by Hair et al. (1998), variables having a factor loading greater than 0.5 are practically significant.

In case one or more variables loaded on more than one factor in the rotated component matrix, we used the component score coefficient matrix (showing the amount of variance accounted for by the factor solution for each variable) and eliminated the variables with communalities less than 0.3 (at least 1/3 of the variance of each variable must be taken into account). Also, variables that did not load on any factor and/or their communalities were too low (<0.3) were ignored in the interpretation.

Computation of Factor Scores

The Anderson-Rubin method was used to compute the factor scores because it ensures the orthogonality of the derived factors; the scores are uncorrelated compared to other methods such as the regression or the Bartlett methods also available on SPSS.

Reliability and Validity

Cronbach's alpha was calculated for the original set of variables before they were reduced through factor analysis to assess the reliability of the measures. A reliable measure of the scale has a Cronbach's alpha value of 0.70 or greater, as suggested by Hair et al. (1998).

We also validated the factor analysis by using an estimated split sample (i.e., we split our sample in two samples of the same size). We validated the factor models by comparing the factor matrices from the two subsets and by comparing them to the developed model (that used the total sample size).

Stepwise Logistic Regression Model

We were primarily interested in predicting whether a given NIPF owner adopted a given practice or not. The nine groups of practices mentioned earlier served as dependent variables after being recoded into dummy variables. Table 2 provides a summary of the variables used for this analysis.

Table 2. Variables used for the logistic regression model.

Dependent variables		Independent variables	
All practices	Dummy	Frequency of attendance of educational programs	Continuous
Harvesting practices	Dummy	Technical assistance	Dummy
Wildlife management practices	Dummy	Use of a written management plan	Dummy
Woodland management practices	Dummy	Financial assistance	Dummy
BMP practices	Dummy	Acreage (acres)	Continuous
Conservation easements	Dummy	Number of tracts owned	Continuous
Use of a written management plan	Dummy	Length of ownership (years)	Continuous
Technical assistance	Dummy	Distance between home and forest (miles)	Continuous
Financial assistance	Dummy	Age	Continuous
		Level of education	Categorical
		Income from forest-related activities (% household income)	Categorical
		Household income ($)	Categorical
		Motivations for owning forest land	Continuous
		Sources of information used for managing land	Continuous
		Constraints to forest management	Continuous

There are three variables that are listed as both dependent variables and predictor variables (adoption of management plan, technical assistance, and financial assistance). These three variables are thought to be mediators of predictors such as educational programs and the practices per se. For instance, a NIPF owner, after attending an educational program realized that

he can have financial assistance through cost-share programs, and then only does he/she implement some practices on his/her land.

All these elements included in our analysis are parts the theoretical Proposed model we developed earlier (Figure 5). In the knowledge phase of the model, variables such as frequency of attendance of educational programs, or the various sources of information used for the purpose of managing the land are elements of the sources of information box; demographics including age, level of education and length of ownership of the land are part of the motivation and ability to process boxes. In the persuasion phase, the different types of motivations for people to own forest land are elements of the subjective norms since everything an individual is going to do (or is doing) on his/her land depends on what his/her objectives are, objectives are part of one's values and beliefs. Elements about the individual's resources such as acreage, number of tracts owned, distance between home and forest land, and household income are elements of the attitude box because it is only by taking these elements into account (resources) and analyzing them with the information and knowledge about the likely results an advertised behavior would produce that a person can estimate the consequences of implementing a given behavior (e.g., the advertised behavior is about using the group selection technique for timber harvesting, but the person owns only two acres of land, with harvestable trees scattered around, then, his/her attitude would likely not adopt that advertised behavior). The different constraints to active forest management variables are classified under perceived behavioral control; as stated in the VBN theory, people find it easier to adopt behaviors with outcomes he/she can control (do not depend on circumstances). Since some of those constraints the individual can control (e.g., poor soil, insufficient time to allocate to management activities) but there are also others he/she cannot, such as development of nearby lands, absence of market for the products, etc. If the outcome of a behavior relies essentially on controllable factors, then there would be more chance for it to be adopted, on the other hand, if the outcome relies on uncontrollable factors, its adoption would be less likely. In the decision phase, development of a written management plan, use of technical assistance, or use of financial assistance are elements of the behavioral intention box because for an individual to invest in those activities, he/she must have already made up his/her mind on trying to implement the behavior but just did not have either one or both of the technical knowledge and the financial means to do so. These activities are very good indicators of the willingness to implement the wanted behaviors. The implementation phase includes all the

practices, including harvesting practices, wildlife management practices, woodland management practices, use of BMPs, use of a written management plan and use of conservation easement programs. The adoption phase involves maintaining the implementation of the practices and/or reinforcing behaviors through either technical assistance, or financial assistance or educational programs.

Several of the dependent variables are actually groups of individual practices; Table 3 summarizes the list of individual practices taken into account for each group of variable.

Table 3. List of individual practices within each dependent variable.

Harvesting practices	Wildlife management practices	Conservation easements
Marking trees prior to harvest	Management of tree species for wildlife	Conversion to other land use restricted
Written contract for timber selling	Habitat protection (against fire)	Road construction restricted
Group selection	Control of invasive species (plant & animals)	Tree harvesting restricted
Seed-tree selection	Protection of special places (springs, pools)	Development restricted
Estimation volume timber prior to selling	Protection against damage from noxious species (deer, beaver, etc)	Splitting forest land into smaller holdings restricted
Single-tree selection	Removal of habitat for noxious species	
Woodland management practices	**Technical assistance**	**Financial assistance**
Site preparation	Woodland management	Reforestation of Timberland
Tree plantation	Wildlife management	Environmental Quality Incentive Program
Tree thinning	Timber sales and harvesting planning	Forest Land Enhancement Program
Tree pruning	Fire safe landscape management	Agricultural BMP cost-share Program
Control of exotic species	Non-timber business assistance	Bmp tax Credit Program
Roads and culverts maintenance	Forest stand management (silviculture)	Conservation Reserve Program
Boundary line survey	Reforestation and planting	Conservation Reserve Enhancement Program
Fire hazard reduction	Recreation and aesthetic planning	Forestry Incentives Program
Prescribed burning	Taxes and estate planning	Wildlife Habitat Incentives Program
Use of fire lanes	Cost-share program assistance	Partners for Fish and Wildlife Program
	Forest health, invasive species, insect management	Wetland Reserve Program
BMPs	**Written management plan**	**All practices**
Using BMP practices	Has one and follows it fully	Harvesting practices
	Has one and somewhat follows it	Wildlife management practices
		Conservation easements
		Woodland management practices
		Technical assistance
		Financial assistance
		BMPs
		Management plan

For the purpose of our analysis, the group of practices was given a score of 0 if the NIPF owner did not implement any of the listed individual practices; if he/she implemented one or more individual practices on his/her land, the group of practices was given a score of 1.

The main goal is to estimate the probability (likelihood) of a NIPF owner to adopt a given practice. A probability of adoption of a practice greater than 0.5 would mean likely adoption and a probability less than 0.5 would suggest likely non-adoption. In brief, with the model developed here, we propose to predict that a given NIPF owner would be either an adopter or a non-adopter of a given practice, knowing his/her attributes about the independent variables.

Requirements

The only requirement for logistic regression is the adequacy of the sample size for the planned analysis. Hair et al. (1998) suggest a minimal ratio of observations to the number of variables to be 5/1, and that each group (0 and 1) has to have a minimum of 20 observations.

Analysis Process

We used the Wald Forward Stepwise Model for entering the independent variables into the model. With this method, a variable is entered based on the significance of the score statistic, and variable removal is based on the probability of the Wald Statistic, which assesses whether the coefficients of the independent variable significantly differ from zero when it is in the model. In other words, at each step, the independent variable having the highest and most significant score statistic is entered first in the model; the second variable is entered in the same way, however, the Wald Statistic assesses whether the variable entered in the previous step still has a coefficient significantly different from zero or not. If the coefficient is significantly different from zero, then, the variable is retained, and if it is not, then the variable is removed from the model. The process continues until no more variables can be entered or removed from the model.

Measures of Goodness of Fit

There are three main measures for the goodness of fit of the model. (1) The -2 log likelihood (-2LL) is the error term, thus, the goal is, for each step in the development of the model, to decrease the value of -2LL; that decrease is expected to be significant at a level of .05 between each step (otherwise the stepwise process stops). A Chi square is used to measure that change in -2LL. (2) The Nagelkerke R square is used to measure the amount of variance in the odds ratio of the dependent variable that is accounted for by the variables in the model so the higher its value is, the better the model fits. (3) The Hosmer and Lemeshow Chi square is used to measure the difference between the predicted and the observed classification of individuals in the

classification matrix; a high value of this Chi square (not significant) means the predicted classification is not significantly different from the actual (observed) classification, thus the model fits well.

The classification matrices show the actual (observed) classification and the predicted classification. The resulting "hit ratios" (percentage of correctly classified cases in the prediction) provides an idea about the fit of the model.

Validation

We divided our sample in two for the purpose of validation for this analysis. Fifty-five percent of the sample was randomly selected and used to develop the model and the remaining 45% was used to validate the model. The measure we use then for the validation of the model is the hit ratio (percentage of correct classification from the prediction) when the model is applied to the holdout sample.

Odds Ratio and Probability of Adoption

The developed model for each group of practices has the following structure:

$$z = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n$$

With: z being the log of the odds ratio for adoption of the given practice;

β_0 being the intercept; and

β_1 …… β_n being the logistic regression coefficients for the predictors (determined during the model development).

The logistic regression coefficients were interpreted in terms of odds ratio for adoption they brought into the equation by using the following formula, given that $e^{(x+y)} = (e^x)(e^y)$.

$$\frac{p_{(adoption)}}{p_{(non\text{-}adoption)}} = e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots + \beta_n X_n)}$$

And the probability of adoption, which is our ultimate objective, was derived from the above equation:

$$p_{(adoption)} = \frac{1}{(1+e^{-z})}$$

Results and Discussion

After elimination of the undeliverable questionnaires, Table 4 provides the response rates obtained.

Table 4. Response rates after removal of the undeliverable questionnaires.

	Number	Percentage
Questionnaires actually delivered	3120	100 %
Total responses	1624	52.1 %
Not usable responses	527	17.0%
Usable responses	1097	35.2 %

The overall response rate was 52% response rate; which is lower compared to Blatner et al. (1991) study, with 69% of response rate, but is similar to that of other surveys, including Potter-Witter (2005), with 55%; Hodge (1993), with 52%, and slightly higher than other studies, including the National Woodland Owner Survey (NWOS) response rate, with 49% (Butler et al. 2007), Creighton and Baumgartner (2005) found 48%, Kendra and Hull (2005), 46.1%. However, due to the relatively high rate of non-usable responses 527 questionnaires in total, we had an overall usable response rate of 35.2%; which is still higher compared to that of Downing and Finley (2005), with 36% after adjustment, Elwood et al. (2003), with 34.2%, or Measells et al. (2005) with 30.7% of adjusted response rate.

Characteristics of the Study Population

Demographics

Age

A total of 1,065 individuals provided age data. The average age of our respondents was 62 years old. Table 5 provides the age distribution of our study population.

Table 5. Age distribution of the study population (N=1065).

Age category	Frequency	Percent
Less than 30 years	3	.3
30 to 44 years	82	7.7
45 to 59 years	397	37.3
60 to 75 years	422	39.7
More than 75 years	161	15.1

The study population included 54.8% of our respondents aged 60 years old or older; less than 8% of our study population was less than 45 years old, while 15% were 75 years old or older. The study population is older than other populations in previous studies, though presenting the same trends. For example, Hodge and Southard's survey (1992) found 50% of Virginia's NIPF owners were over 60 years of age. Birch (1996) found that 45% of NIPF owners are older than 55 and 33% were retired. Downing and Finley (2005) also found the average age of NIPF was 57 years.

Household income

The average annual household income of respondents was between $50,000 and $99,999, with more than 70% earning $50,000 or higher (Table 6). Downing and Finley (2005) found that over 40% of NIPF owners earned $50,000 or more. Our results are consistent with Johnson et al.'s (1997) who found an average annual income of $61,000, but suggest that our study population earned more than Hodge's (1993) who found 55% of respondents earning higher than $40,000.

Table 6. Distribution of household income (N=957).

Annual household income	Frequency	Percent
Less than $25,000	85	8.9
$25,000 to $49,999	198	20.7
$50,000 to $99,999	378	39.5
$100,000 to $199,999	192	20.1
$200,000 or more	104	10.9

The proportion of income derived from forest-related activities was 3% despite the fact that 75% of the respondents actually earned 2% or less of their income from forest-related activities. Only 1.81% of respondents earned one-quarter or more of their annual household income from forest-related activities (Table 7).

Table 7. Income generated by forest-related activities (N=997).

% household income generated from forest-related activities	Frequency	Percent
Less than 25%	979	98.2
25 to 49%	11	1.1
50 to 75%	4	.4
More than 75%	3	.3

Level of Education

Fifty-seven percent of our respondents have a bachelors degree or more (Table 8) compared to 30% for the general public (Stoops, 2004) and 45% of respondents having any college degree in Hodge's study (1993). Also, only 5% of our respondents went to 12th grade or less compared to 15% for the general public (Stoops, 2004). Downing and Finley (2005) reported fairly high level of education for NIPF owners as well, with 70% of them having at least an associate degree. These facts suggest that our study population is relatively well educated compared to the general public. Table 8 below provides the distribution of the respondents according to their level of education.

Table 8. Frequency table for level of education (N=1,072).

Level of education	Frequency	Percent
Less than 12th grade	49	4.6
High school graduate or GED	167	15.6
Some college	157	14.7
Associate or technical degree	93	8.7
Bachelor degree	312	29.1
Graduate degree	294	27.4

Table 9 provides descriptive statistics for information obtained from the usable responses. All variables in table 9 have continuous values.

Table 9. Descriptive statistics for variables in the survey.

	N	Minimum	Maximum	Mean	Std. Deviation
Age (Years)	1065	26	98	62.45	12.057
Household income earned from forest-related activities (%)	997	0	100	2.97	9.023
Acreage (acres)	1028	2	3000	172.77	303.215
Number of tracts of forest land owned	992	0	55	2.36	3.328
Length of ownership (years)	1033	0	79	24.71	14.607
Distance between farm and forest land (miles)	525	0	169	1.31	10.507
The distance between primary residence and forest land (miles)	913	0	5000	23.62	197.650
Frequency of attendance of educational programs	1075	0	10	1.89	2.771

Table 10 displays the frequencies of respondents who provided positive responses (Yes) to the statements in the table (from a yes/no questions). All variables in table 10 represent the percentage of the positive responses.

Table 10. Frequency table for variables collected from the survey.

	N	Frequency (%)
Directly participated in the management of forest land	879	72
Used technical assistance (professional help)	1083	54
Used a written management plan in land management	1041	28
Harvested at some point in the past 11 years	1079	61
Allowed the logger to harvest without any contract	658	20
Let the logger choose the trees to harvest	658	24
Actually used harvesting practices	658	89
Reasons for managing land included wildlife management	1068	55
Actually used wildlife management practices	586	78
Actually used woodland management practices	983	86
Aware about best management practices	1054	77
Actually used best management practices on their land	731	73
Used financial assistance in the past 11 years	1056	23
Actually used any type of cost-share program	1056	22
Used conservation easement programs at some point	1054	7
Actually used any conservation easement program	1054	7
Used any type of source of information to manage land	1068	67
Attended of any educational program at some point	1075	53

Resources

Acreage

The average acreage owned by the respondents was 173 acres, ranging from 2 to 3,000 acres (N=1,028). Fifty percent of respondents owned 80 acres or less though, and 75% owned 180 acres or less. Those results confirm previous studies about NIPF owners; Dedrick (1999), for example, found that 51% of all Virginia NIPF are less than 100 acres, and Downing and Finley (2005) found that 84% of owners had less than 200 acres. However, Kuhns et al. (1998) stated that 95% of NIPF owners nationally own less than 100 acres. Although other studies, including Measells et al. (2005) found larger average acreage compared to ours, with 330 acres, the majority of them suggest that our population has somewhat larger land holdings than NIPF owners across the country.

Number of tracts

Respondents owned two tracts on average (N=992). Half of the respondents (50.1%) owned a single tract and the other half (49.9%) owned two tracts or more. These numbers somewhat differ from Birch's (1997), who found that only 31% of owners were classified as owning more than one tract of forest land.

Length of land tenure

The average length of ownership is 24 years ranging from less than a year to 79 years (N=1,033). The first three quartiles were 13 years, 22 years, and 34 years. Compared to Birch (1996) who found 15 years of tenure for 64% of the NIPF land, our study population presented 31.4%. Our average land tenure was exactly the same as Pan et al.'s (2007), which was 24 years. Nagubadi et al. (1996) also found a very similar average in land tenure, which was 23 years.

Distance between forest and farm/home

The average distance between the respondent's farm and his/her forest land was 1.3 miles (range from 0 to 169 miles) with 75% of respondents owning their farm on one of their forest land tracts (N=525).

Sixty-two percent of the respondents lived within one mile from their forest land (N=913), compared to 67% of NIPF owners in Birch's study (1996). If we consider the definition of absentee owners used by Shaffer (1997) as NIPF owners living more than 50 miles away from their forest land, out of the 913 responses, 8% of owners were classified as absentee owners compared to 16 %, 14%, and 32% respectively for Shaffer (1997), Birch (1997) and Hodge (1993). The discrepancy seems to indicate that the hypothesis suggested by Shaffer (1997), that absentee owners are more likely to respond to a mail survey concerning their forest land, does not apply to the general population of NIPF owners of these three studies. Only Hodge's used the same mode of administration and data collection method as we did, but it yielded the most discrepancy in results compared to ours.

Educational Programs

One of the main goals of this research is to determine whether or not educational programs had any effect on the implementation of practices. Table 11 shows the distribution of attendance at educational programs by landowners in the last 11 years.

Table 11. Attendance of educational programs (N=1,075).

Number of educational programs attended	Frequency	Percent
None	505	47
One	192	18
Two to five	256	24
Six to ten	72	7
More than ten	50	5

Almost half of our respondents never attended any formal educational program in the last 11 years and 88% of them attended five times or less, meaning at most once every two years. Here as well, we can say that our study population differs from the general population of NIPF owners because previous studies found that there were only 14% of owners who attended at forestry-related educational programs (Measells et al., 2005). Educational programs, along with other elements like sources of information, are part of the knowledge phase in our theoretical model (Figure 5). We expected educational programs to help people consider adopting SFM practices unless the latter contradicted their subjective norms.

Practices

Technical assistance

A total of 1,083 people responded to the technical assistance questions; 57% of them used technical assistance from professionals in a field related to forest land management at least once at some point in the last 11 years. This number is more than the double of what other studies showed: only 23% of NIPF owners in Georgia received some sort of technical assistance (Crowther, 1990), 16% from Butler et al. (2007), and 20% from Jones et al. (1995). Table 12 summarizes the results about the source, type and use of professional help by respondents.

Table 12. Technical assistance providers and types of technical assistance (N=1,083).

Types of technical assistance used	Freq.	%
Woodland management plan	347	32
Wildlife management plan	173	16
Timber sales and harvesting plan	379	35
Fire-related landscape management	54	5
Forest health, invasive species, etc.	130	12
Real estate investment	43	4
Non-timber business assistance	32	3
Silviculture techniques	162	15
Reforestation and planting	249	23
Recreation and aesthetic planning	76	7
Taxes and estate planning	119	11
Cost-share program assistance	152	14
Other type of assistance used	22	2

Technical assistance providers	Freq.	%
Private consulting forester	336	31
Private consulting wildlife specialist	32	3
Virginia Department of Forestry (forester)	433	40
VDGIF (biologist)	97	9
Forest industry landowner assistance program	76	7
Extension agent	173	16
Certified public accountant	87	8
Lawyer	87	8
Logging firm or timber buyer	292	27
Other type of professional help	32	3

The first three columns of Table 12 provide information about the different types of technical assistance landowners sought. Timber selling and harvesting planning were the most sought after assistance, with 35% of respondents having asked for it. The next most used technical assistance was woodland management planning (32%) and reforestation (23%). The least used types of technical assistance were non-timber business assistance (only 3%), real estate investment (4%), and fire-safe landscape management (5%).

The last three columns of the Table 12 show that the Virginia Department of Forestry (VDOF) foresters are the professionals that landowners solicited the most to get technical assistance from, with 40% of respondents having asked help from them. This finding seems to go along with what the Roper Public Affairs and Media study (2007) found, which states that state foresters are preferred to private consulting foresters. Private consulting foresters were the second most solicited group (31%). Only 27% of owners received technical assistance from foresters from logging firms or timber buyers who according to previous studies “are there primarily to make the most money out of the operations, thus scarcely solicited by model owners” (Roper Public Affairs and Media, 2007). This was possibly because owners chose their foresters from word-to-mouth and if friends harvested their land in the past and they were satisfied with the job, they were likely to recommend the same people to their friends. The least solicited professionals were private consulting wildlife specialists (3%), forest industry landowner assistance program (7%) and public accountant and lawyers (8% each). Our results

were also consistent with West et al. (1988), who found that state or federal foresters were used as sources of communication by 28%, and private foresters by 24% of NIPF owners.

Considering these numbers with the acreage variable, we could compare our results to what Crowther (1990) found. He found that technical assistance from state foresters was mostly used by owners of small parcels, and that consultant foresters' technical assistance was mostly used by owners of medium-sized parcels. A one-way ANOVA test was used to compare the different technical assistance providers. It used technical assistance providers as the independent variable and acreage as the dependent variable; and showed no significant difference in terms of acreage owned across the different technical assistance providers; with an F value of 0.837, significant at a level of 0.570. This result means that unlike Crowther's (1990) findings, owners using technical assistance from state foresters and those using assistance from private consulting foresters did not differ in terms of acreage owned.

Another test was used to compare the group of owners who used technical assistance and those who did not for each individual practice. This was done using a two sample t- test; the results (Table 13) showed that there was a significant difference in terms of land size owned between people who used and who did not use technical assistance from any of the technical assistance providers. The common trend is that NIPF owners having used technical assistance own more land than those who did not. This result applies to all assistance providers (Table 12).

Table 13. t-test results of technical assistance providers used in land size.

Assistance provider	Used assistance	N	Acreage mean	t-value	Significance
Private consulting forester	No	703	118.48	-6.954	.000
	Yes	312	299.28		
Private consulting wildlife specialist	No	981	167.60	-3.382	.002
	Yes	34	360.24		
Virginia Department of Forestry	No	610	125.88	-5.762	.000
	Yes	405	246.62		
Virginia Department of game and Inland Fisheries	No	919	161.68	-3.561	.001
	Yes	96	292.49		
Forest industry landowner assistance program	No	936	154.84	-4.596	.000
	Yes	79	401.71		
Extension agent	No	846	166.45	-2.033	.043
	Yes	169	212.11		
Certified public accountant	No	929	150.99	-4.294	.000
	Yes	86	423.19		
Lawyer	No	929	155.64	-3.855	.000
	Yes	86	373		
Logging firm or timber buyer	No	734	146.46	-4.232	.000
	Yes	281	246.14		

The Roper Public Affairs and Media study (2007) found four reasons for owners not to use technical assistance include the *distrust* toward foresters, from personal experience or from friends' experience); *financially-related obstacle*, consultations are expected to be expensive, or are actually expensive, some owners are even worried about their eventual liability should a logger be injured on his land); *lack of awareness*, the owners just do not know the options they have (especially new owners); and the feeling of *not having anything to learn*: Some owners say they do not need an expert, they know enough.

Written management plan

Tables 14 and 15 present the status of having used and/or using a written management plan for managing forest land (N=1,041).

Table 14. Distribution of the use and ownership of a written management plan (N=1,041).

Use of a written management plan	Frequency	Percent
Not interested in having one	405	39
Not having one but interested in the future	268	26
Currently developing one	47	5
Having one but not using it at all	33	3
Having one and somewhat following it	160	15
Having one and fully following it	128	12

Table 15. Reasons for not using a written management plan (N=1,041).

Reasons for not having and/or using a written management plan	Frequency	Percent
Never thought about it	202	19
Too expensive	43	4
Not worth investment (prefers doing something else with the same amount)	43	4
Cannot afford the cost of implementing it fully	85	8
Not necessary for managing the land	234	22
Not enough land for management to be worthy	117	11
Insufficient knowledge to develop the plan	96	9
Not a priority (though interested in having one in the future)	64	6
Not enough time spent on land to keep up with managing it	64	6
Not physically able to implement the plan	75	7
Has the expertise to manage land without a written management plan	128	12
Has no trust in foresters	32	3
Other reasons for not having and/or using a written management plan	43	4

Overall, only 12% owned and followed their management plan; this number is consistent with previous studies (Jones et al., 1995; Birch, 1996); Measells et al., 2005; Butler and Leatherberry, 2004); 15% had a written management plan but did not follow it fully, and 3% had a plan but did not use it at all. The predominant group is that of owners who did not have any written management plan and were not interested in having one, they accounted for 39% of the total responses. This result may be explained by the fact that these owners did not know exactly what the terms mean and thought that a plan would infringe on their right to control the land (Roper Public Affairs and Media, 2007). Another explanation suggested by the same study was that these owners thought that planning/management was only for larger owners, not for small ones like them. The next biggest group was that of owners who did not have a plan but were interested in having one; they accounted for 26% of the total responses. These results reflect the chronic problem of NIPF owners not having any written management plan found by previous researchers such as Birch (1996) who found that there were only 5% of NIPF owners having a written management plan, Measells et al. (2005) found 11%, Butler and Leatherberry (2004) found that 3% of NIPF owners owning a written management plan. Many reasons could explain why owners did not use a written management plan, for example:

(1) Almost a quarter of our respondents (22%) stated that they did not use any written management plan because it was not necessary for managing their forest land. (2) The next biggest reason was that respondents simply never thought about having and using one, they accounted for 19% of the total responses. (3) Another 12% of the population said they had the expertise to manage their land without the use of a written management plan. (4) Eleven percent stated that their land was too small to justify the use of a written management plan. DeCoster (1998) also came to the same conclusion for small forest owners; he stated that “owners of smaller forests may not feel a need to actively manage their forest.” Interestingly, only 4% of respondents mentioned the cost of developing such a plan, while another 4% judged it was not worth the investment. Three percent of our respondents stated that they did not have a written management plan because they did not trust foresters. Other studies, including that of Roper Public Affairs and Media (2007) found that a written management plan was part of several elements that had limited appeal for NIPF owners because of the feeling of outside control it implies to owners.

By relating these reasons to our theoretical Proposed model (Figure 5) we can see that responses such as “it is not necessary to have a plan”, “I do not trust foresters” or “I have the expertise, and do not need a written plan” are inhibitors of the *motivation to process* box, more specifically, the person does not think the subject is relevant for him/her; and as explained earlier, when a person is not motivated to process, the outcome is less likely to lead to a change of behavior. Other reasons, such as “my land is too small” or “a plan is not worth the investment” have some effect during the persuasion phase, more specifically in developing the attitude by evaluating the eventual consequences of using a written plan. All of these leave us with only one group, the group of NIPF owners who did not use a written plan just because they never thought about it. This group is likely the part of the NIPF owners population that Cooperative Extension has the most chance to reach for behavioral change, thus needs to sensitize because it is a group that is not against the use of the plan (neither the motivation process, nor the subjective norms are standing against the use of a plan). If this group is involved there could be a substantial gain in the proportion of NIPF owners using written management plans because they accounted for 19% of our respondents.

Harvesting

Sixty-one percent of respondents harvested at least once in the last 11 years (N=1,079). This number is higher than Birch’s (1996); he stated 46% of NIPF owners had harvested. That might suggest that our study population was more inclined to timber harvesting than general NIPF owners. An independent sample t-test showed a significant difference in terms of the mean acreage between the NIPF who had harvested (222 acres) and NIPF owners who did not (100 acres); the t value is of -7.311, highly significant (0.000). This result agreed with Birch’s (1996) finding that “those who did not harvest likely owned fewer acres”. Also, the total acreage under the control of people who did not harvest was only about 23% of the total acreage under NIPF owners’ control; this means 77% of the land was controlled by those who had harvested. These results are similar to Birch’s (1996) finding that 46% of NIPF owners have harvested but they controlled 78% of NIPF land (in our case, it was 61% of NIPF having had harvested and controlling 77% of the land). Many reasons could explain why landowners harvested at some point in the last 11 years (Table 16).

Table 16. Reasons for harvesting timber (N=658).

Reasons for harvesting	Frequency	Percent
To improve forest health	270	41
To obtain products for personal use (firewood, building materials, etc)	211	32
To achieve objectives in my management plan	191	29
To improve marketability of remaining trees	165	25
To clear land for conversion to another use (e.g. road, building, pasture, etc)	118	18
Price was right	105	16
To improve hunting opportunities	86	13
To generate a regular flow of income	72	11
To generate money for an emergency (e.g. health-related emergency, etc)	46	7
To minimize risk of wildfire	46	7
To improve scenery and recreational opportunities	46	7

The primary reason why respondents harvested was for the purpose of improving forest health (41%). Moser et al. (2005) found that 54% of NIPF harvested timber for the same reason. Utilitarian use of the forest (personal use) was relatively high in importance at 32%, which is close to the findings of Moser et al. (2005). The purpose of achieving objectives stated in the owners' management plan (29%) is higher than Moser et al. (2005), with 18%. The three least cited reasons for harvesting included emergency need for money, minimization of risk of wildfire, and for improving scenery and recreational opportunities (all three accounted for 7% each). Along with their similarities to Moser et al. (2005) findings, our results are also similar to other studies' such as that of Roper Public Affairs and Media (2007), which found six main reasons for NIPF owners to harvest: *financial reasons* (selling timber to pay taxes, for income or for a need for money), for improving *forest health* (helping younger trees to grow, taking out the unhealthy), for the *animals* (more food for wildlife), *beautification* (better view, prettier scenery, or nicer driveway), *recreation* (clearing paths for various activities), for *household use of wood* (cording, firewood, furniture, build a house, etc.).

Table 17 provides details about different practices related to harvesting that landowners could have used at the time they harvested.

Table 17. Harvesting practices and regeneration systems implementation (N=658).

Harvesting practices implemented on the land	Frequency	Percent
Had a written contract for timber selling	303	46
Marked the trees prior to the harvest	184	28
Estimated the volume of timber products to sell prior to the harvest	168	25
Used regeneration systems	158	24
The logger was given the choice of trees to harvest	158	24
Used diameter-based harvesting as harvesting practice	132	20
A logger harvested timber without any written contract	132	20

The use of a written contract for timber selling was the most widely used practice (46%), followed by tree marking before the harvest (28%), estimation of the volume of timber before harvest (25%) and regeneration systems (24%). It is interesting to note that between 20 and 25% of NIPF owners stated that loggers harvest timber on their land at their will. The last three practices in Table 17 are not considered sustainable, and we did not count them in our analysis as part of sustainable harvesting practices. One explanation of such behavior is that owners make decisions based essentially on trust and in consequence, they prefer dealing with loggers they already know, have personal relationship with, or friends/family they already know through the word-to mouth type of communication (Roper Public Affairs and Media, 2007).

Wildlife management

Fifty-five percent of 1,068 respondents stated that wildlife management was part of their objectives in managing their forest land. Table 18 provides more details about the types of practices respondents were implementing on their land.

Table 18. Wildlife management practices implemented (N=586).

Wildlife management practices implemented	Frequency	Percent
Management of certain tree species: those providing food for wildlife over others	270	46
Protection of habitat by creating fire lines,	94	16
Controlling invasive species (plant as well as animal)	188	32
Placing nesting boxes	188	32
Placing food plots	293	50
Installing ponds or water holes	176	30
Protecting special places like springs and pools	234	40
Remove habitat to discourage certain species (i.e. beaver, deer)	53	9
Protect vegetation against damages by noxious species (i.e. beaver, deer)	94	16
Other wildlife management practices implemented	29	5

Practices related to the provision of food and to the protection of special places were the predominant practices used. Placement of food plots was the most commonly used practice (50%) followed by the management of certain tree species that provide food for wildlife over others (46%) and protection of special places like springs and pools (40%).

Woodland management

Table 19 shows how commonly NIPF owners use different practices related to woodland management on their land.

Table 19. Woodland management practices implemented (N=983).

Woodland management practices implemented	Frequency	Percent
Posted land to restrict public access	659	67
Maintained roads and culverts	521	53
Built or performed maintenance on roads or trails	452	46
Planted trees	413	42
Thinned trees	374	38
Put up gates	354	36
Conducted a boundary line survey	305	31
Applied herbicides, pesticides, or fertilizers	275	28
Maintained painted boundary lines	256	26
Prepared land for new trees (site preparation)	226	23
Pruned trees	197	20
Protected cultural features like cemeteries	157	16
Controlled exotic species	138	14
Reduced fire hazard	98	10
Prescribed burning	98	10
None of the above	79	8
Used fire lanes	59	6

The three most implemented practices were posting land (67%), followed by maintaining roads and culverts (53%), and building roads and trails (46%). The least used practices in the list were fire-related ones: use of fire lanes (6%), reduced fire hazards and prescribed burning (10% each).

Best Management Practices

For NIPF owners who had harvested at some point during their forest land tenure, the use of BMPs is an indicator of whether they were implementing sustainable forestry practices or not. Seventy-seven percent of 1,054 respondents were aware of the Virginia BMPs; that number included owners who harvested at some point during the last 11 years and those who did not.

Table 20 shows the distribution of respondents who used BMPs on their land and those who did not.

Table 20. Implementation of best management practices among landowners who harvested (N=731).

Use of BMPs	Frequency	Percent
BMPs not implemented	196	27
BMPs implemented	535	73

Financial assistance

The most common form of financial assistance to landowners is the cost-share program. Table 21 shows some of the most commonly used cost-share programs in Virginia.

Table 21. Types of cost-share programs used (N=1,056).

Types of cost-share programs used	Frequency	Percent
Environmental protection	95	9
Wildlife	32	3
Woodlands	211	20
Water quality	43	4
Wetlands	0	0

Those 12 programs can be grouped into five according to their main purposes:
Environmental protection (EQIP, CRP, and CREP)
Wildlife (WHIP, PFW)
Woodlands (RT, FLEP, FIP)
Water quality (VBMP, BMPTC, NM)
Wetlands (WRP)

Programs related to woodland management were most used by NIPF owners, accounting for 20% of the respondents (especially reforestation of timberlands used by 15%), followed by environmental protection-related programs, with 9%, water quality-related programs, with 4% of respondents; wildlife management, accounting for 3% of respondents and finally only one program related to protection/restoration of wetlands was not used at all. A possible reason that might explain why landowners were not interested in programs such as Wetlands Reserve

Program is that the contract can bring the land under permanent easement, or a 30-year easement, which would be very limiting in terms of future options for the landowner. Perhaps for the same reason, Reforestation of Timberlands was the most popular program because the landowner had more flexibility in the present because his/her benefits would depend on the type of species he/she will plant on the land, and in the future because the practices must be maintained only for a period of 10 years, after which, the owner can choose whether he/she will maintain the same land use or change. Once again, these examples are related to the notion of perceived behavioral control in the model (Figure 5) that the owners have upon adopting the financial assistance programs; programs such as the Wetlands Reserve Program takes away their control from their land while others such as Reforestation of Timberlands are much less restrictive, thus more controllable and more likely to be adopted.

Conservation easements

In this study, we considered five main types of conservation easements that a landowner could implement on his/her land. Of 1,054 respondents, only 7% stated they had put any part of their land under conservation easement at some point in the past 11 years. Butler et al. (2007) found a similar result, with only 3% of the NIPF owners having conservation easements. These results reflect the perception that programs such as conservation easements are threatening NIPF owners' control over their land. Furthermore NIPF owners did not find them appealing because they realize they are not meant to benefit individual owners, rather to group ownerships to prevent forest fragmentation, or development (Roper Public Affairs and Media, 2007). Table 22 shows the types of restrictions NIPF owners preferred to put their land on.

Table 22. Types of restrictions on lands put under conservation easements by owners (N=74).

Restrictions	Frequency	Percent
Restriction of building houses or other structures	63	85
Restriction of splitting of forest land into smaller land holdings	42	57
Restriction of conversion of forest land to another land use	32	43
Restriction of building roads	32	43
Restriction of tree harvesting	21	28

Landowners preferred restricting houses or other structures building on their land (85%) over other types of conservation easements. The next type of easement used is the prevention of land from being parcelized (57%). And the least used conservation easement practice was harvesting restriction on landowners' land.

Sources of information

For landowners, managing their forest land suggests they had used some sources of information that could be from professionals or not. Out of 1,068 respondents, only 67% of 1068 respondents used some source of information for purposes related to the management of their forest land at least once in the last 11 years (Table 23).

Table 23. Provider of information about forest land management (N=1,068).

Information provider	Frequency	Percent
Virginia Department of Forestry	577	54
Private consultant, such as a forester or a biologist	267	25
Extension forester or other university employee	224	21
Magazine, newspaper, newsletter	224	21
Other forest landowner	139	13
Neighbors, friends, family	139	13
Conservation/environmental organizations	128	12
Internet/web	117	11
A forester from a company that produces forest products	96	9
Logging contractor	96	9
Arborist	43	4
Lawn and garden company	32	3
Television/radio	32	3
Local government	21	2

The Virginia Department of Forestry (VDOF) was the most used source of information, with 54% of respondents. Private consultants (foresters or biologists) are next, with 25% of respondents; followed by extension foresters or other university employees, used by the same number of people as magazines, newspapers, and newsletters (21%). Only 13% of owners used neighbors, friends, family, or other forest owners as a source of information. The Roper public and media study (2007) found that owners use mostly their friends, family, neighbors to get information about land management in general; also, they do not really prefer getting information from government offices/programs because of the regulatory notion that they attach to them. West et al. (1988) also found that peer influence was a significant source of advice for

management activities among NIPF owners. Our results contrast with Roper and West et al.'s (1988) findings. A logical explanation is that owners first turn to their family, friends and neighbors to get the information they need. If these people cannot satisfy their need, they can recommend other trustworthy sources of information that they might have used in the past. When needed information is too technical, puts important things at stake, or involves legal issues, owners ultimately get the needed information only from professionals, including as state agencies. Also, only 11% of respondents were using internet to get information about forest management; this result is similar to that of Butler et al. (2007), saying that internet was medium least likely to provide useful information.

Apart from the source of information used, there is also a wide variety of material supports available for landowners to acquire information related to their need to manage their land. Table 24 shows the importance of information sources for managing forest land.

Table 24. Frequencies (in %) of the rating for the types of information channel used for land management (N=765).

Types of material	Don't know	Not useful	Somewhat not useful	Somewhat useful	Very useful
Talking with a forester or other natural resource professional	11	3	3	25	58
Publications, books or pamphlets	9	2	3	38	48
Newsletters, magazines, or newspaper	10	2	7	40	40
Attended workshops/short courses with support materials	18	5	8	30	39
Visiting other forest lands or field trips	21	6	10	33	31
Talking with other forest land owners	20	6	10	41	24
Internet/web	25	9	13	30	22
Conferences or videoconferences	28	10	18	27	16
Video tapes or DVDs for home viewing	30	11	15	27	17
Television or radio programs	28	9	19	35	10
Talking with a logging contractor	27	14	18	30	11
Membership in a land owner organization	36	12	18	23	11

The two most highly preferred type of support were "publications, books, and pamphlets", with 86% who rated them very useful. "Direct interaction with natural resources professionals" was the next most highly preferred source of information, 83% of respondents found it useful. Overall, hands-on sources of information tended to be preferred to other self-learning type of information like internet or video and DVDs. This fact was confirmed by West et al. (1988), who stated that "personal contact is more effective in transmitting specific NIPF

management advice, and in gaining adoption of that advice, especially for timber management and timber harvesting."

Membership in a landowner organization was uncertain as to its usefulness in providing relevant information about forest land management (36% of respondents did not know), followed by videos and DVDs. For our sample, written materials (books, magazines and newspapers) tended to be easily identifiable by landowners and are among the most highly ranked as providing useful information about forest land management; this is consistent with Kuhns et al. (1998), who found that owners with higher educational level used written materials more than those with lower educational level.

The importance of written materials in helping owners to manage their land was similar in our study and that of Butler et al. (2007), who found that the most preferred information channel for NIPF owners in general is through publications. However, other authors, including West et al. (1988) found that written materials "heighten general awareness of NIPF about management issues but are not effective channels for transmitting specific management advice, and are only minimally effective in convincing owners to change management practices". In other words, written materials rank high in promoting a general awareness but not in actual use for specific management issues.

The proportions of owners using the different types of information providers are similar for both resident and absentee owners (Table 25); state agencies were most used as information providers in both groups.

Table 25. Use of information providers for resident and absentee owners (N=913).

	Resident owners (N=837)	Absentee owners (N=76)
	Used (%)	Used (%)
Virginia Department of Forestry	54	51
Lawn and garden company	3	1
Arborist	3	5
Extension forester or other university employee	20	24
Private consultant, such as a forester or a biologist	26	20
A forester from a company that produces forest products	10	8
Local government	3	1
Logging contractor	11	5
Other forest landowner	13	11
Neighbors, friends, family	13	11
Television/radio	3	4
Magazine, newspaper, newsletter	21	18
Conservation/environmental organizations	12	8
Internet/web	12	5

Labor

The unit used to calculate labor was the eight-hour workday. The average labor used for the management of forest land throughout the year was 16 workdays, with values ranging from 0 to 462 workdays. Summer was the season that required the most labor (6 workdays), followed by spring (5 workdays), fall (3 workdays) and winter (2 workdays). Seventy-two percent of respondents directly participated in activities related to their forest management (N=879). Though this variable (labor) is important, we could not use it in developing the models for predicting the adoption of practices because too few respondents provided answers to the items related to it in the questionnaire (N=304); using it in the model would have decreased the number of cases for developing the model considerably.

Motivations

Table 26 presents the importance of the motivations for owners to own their land; 1,084 respondents provided the analyzed data. The two most highly rated motivations were scenery (to enjoy the beauty of the scenery), with 88% of respondents rating it as important motivation to own land. The second most highly rated was motivations about biodiversity protection, with 86% of respondents rating it as important. It is interesting to see that only one the economic-related

motivation (real estate) was part of the most highly rated motivations. The lowest rated motivation was “owning land for secondary residency”, with only 16% of respondents who rated it as important. Owning the land as a source of supplementary income was not a highly regarded motivation either, with only 23% respondents who rated it as having some importance.

Table 26. Frequency (in %) of motivations for owning forest land by importance (N= 1,084).

Motivations	Very unimportant	Somewhat unimportant	Somewhat important	Very important
To enjoy beauty or scenery	1	3	21	67
To protect nature and its diverse animal and plant species	1	4	28	58
For privacy	3	6	24	50
To pass land on to my children or other heirs	5	9	26	46
For land investment (real estate)	9	16	31	33
Part of my home	4	4	14	50
To have a healthy lifestyle	6	12	29	34
For hunting or fishing	11	13	25	34
For recreation other than fishing and hunting	9	13	31	25
Part of my farm	3	5	13	42
For production of sawlogs, pulpwood or other timber products	12	13	28	27
For production of energy (firewood, biofuel)	12	19	29	18
As retirement fund	15	16	25	17
For cultivation/collection of non timber forest products	17	20	19	8
To supplement yearly income	20	19	15	8
Part of my vacation home	5	5	7	9

Seventy two percent of our respondents stated that passing the land to their heirs was important; Butler et al., (2007) came up even with a much larger number; they found that 76% of the NIPF owners, controlling 78% of the NIPF forest land keep the land for later passing it to their heirs. These results also reflect the finding of Roper Public Affairs and Media (2007): “the legacy concept was very important for owners, despite the fact that the following generation might not want the land. The sole fact of passing the land down is perceived as being a way to be remembered (in some sense, to live on)”. These facts suggest the trend to higher emphasis on amenity values and less on timber production and economic values tapped from the forest. However, it is also interesting to see here that 27% of our respondents owned their land primarily for timber production; which is different from Birch (1996), stating that only 3% of NIPF owners

hold their land primarily for timber production; Moser et al. (2005) had even a smaller number, they estimated only 1% of NIPF owners own their land primarily for timber production. The most cited as being the primary reason for owning land in Moser et al. (2005) study was that forest was just a "part of the farm" (40%), which is almost identical to our results (42%, Figure 8), the second most important reason. The same study also found that "enjoy the woods" was the second-highest ranked reason for owning land, followed by recreation, land investment, and biodiversity; our study found the same reasons highly ranked as well but the order was not the same because we had scenery (the equivalent of enjoying woods), biodiversity and land investment was much less. On the other end of the spectrum, the most unimportant motivation was "to own land as a source of supplemental income" (20%), followed by the production of non-timber forest products (NTFPs), with 17% and retirement fund (15%).

Birch (1996) also found that 40% of NIPF owners own their land just because it is part of their residence, compared to 50% for our study population. Butler et al. (2007) found similar results as ours because in their study, though owners primarily own their land for noncommercial reasons, 41% of them (who owned 70% of the total NIPF land) had harvested trees for commercial purposes at some point during their land tenure.

All of these results indicate that NIPF owners do not have one single motivation, but several at the same time; and that though more and more owners attribute a greater importance to amenity values of the forest; economical motivations remain present and still important.

Constraints to Active Forest Management

There are many factors that affect a landowner's management decision. Table 27 shows a number of them. We can see that lack of resources (time, labor, and finance) to allocate to the tasks related to forest management were the most limiting factors to forest management. Environmental concerns were not as limiting as were resource limitations, but were more limiting compared to constraints exogenous to the owner, such as timber theft, or lack of market did not really represent major limitations to practice SFM.

Table 27. Frequency (in %) of perception of constraints to forest management (N=971).

Constraints	Not limiting	Somewhat limiting	Very limiting
Not enough time to allocate to forest management tasks.	28	32	19
Not enough labor to allocate to forest management tasks.	29	29	17
High property taxes	39	25	14
Not enough financial means to afford management costs	35	29	13
Trespassing, poaching and dumping	39	23	11
Concerns about environmental damages caused by harvesting equipments	42	20	11
Insufficient profit from management or harvest	34	25	9
Too small acreage to make management worthwhile	43	20	8
Development of nearby lands	45	17	7
Managing my land is not cost effective	42	22	7
Difficulty finding logger	44	16	7
Fear of lawsuits	51	15	5
Soil (poor soil or wet soil)	47	20	5
Difficulty finding professional forestry advice	53	12	5
Dealing with endangered species	50	9	4
Regulations that restrict harvests	49	16	4
No local market for the forest products I wanted to sell	44	16	4
People stealing my trees	49	8	4
Damage or noise from motorized vehicles	51	9	3
Neighbors complain about forest management	54	6	2

Previous studies, such as Arano et al. (2004) identified three main reasons constraining NIPF owners from managing their land: (1) the belief that forests does not need any management, mother nature will take care of itself; (2) Owners just lack information on the options that might help them do what they want to, and (3) The high cost of managing the land. Gan and Kolison (1999), as well as Measells et al. (2005) also found similar constraints by emphasizing that the factors preventing owners from optimizing their land potential were related to their lack of capital, lack of knowledge, and lack of participation in educational opportunities.

If we look closely at these three barriers identified by Arano et al., (2004) we see that two of them can realistically be addressed by the tools Cooperative Extension has. The lack of awareness can be addressed with educational programs, which would provide owners with options they can choose from, then, depending on the chosen options, additional income could be generated, which would offset the costs of management. Only the first barrier is very difficult to address because it is related to the subjective norms of the person (Figure 5).

Another constraint to active forest management for owners is the fact that the forestry community only focused on the model owners (referred to as innovators by Rogers, 2003) and

tailored their approach to their needs. The consequence was that their message did not pertain to the majority of NIPF owners when they are reached (many more were not reached); Butler et al. (2007) gave an analogy of the forestry community approach as preaching to the proverbial choir. Related to that point is the lack of technical expertise of owners, which limits their responsiveness to favorable investment opportunities (Proyer, 1987). There are also constant threats to the ownership of the land as the Roper Public Affairs and Media study (2007) found; they can be grouped in four different categories: (1) financially-related threats, including the offers to buy (targeting aging and/or financially struggling owners), financial pressures (the cost of maintaining the land and paying taxes can be very heavy); (2) intergenerational land transfer: indeed, elder owners wish to transfer the land but the next generation may not want to take it because of the tax bills and maintenance cost; (3) development: it represents a big threat to private ownership by taking over forests for housing development and malls; and (4) loss of owner control: government rules dictating to owners what they can and cannot do make some of them wonder if it is worth keeping the land.

Self-Rated Attitude Toward Innovation

People's attitudes toward innovations vary considerably. According to Rogers (2003), each individual of the population can be put into one of five categories: Innovators, early adopters, early majority, late majority, and laggards. In our study, we asked the subjects to put themselves into one of the five categories according to their perception of their attitude toward innovation. The results are shown in Table 28.

Table 28. Self-classification of respondents based on attitude toward innovation (N=997).

	Our study		Rogers' study
Category	Frequency	Percent	Percent
Laggards	219	22.0	16
Late majority	104	10.4	34
Early majority	280	28.1	34
Early adopters	169	17.0	13.5
Innovators	225	22.6	2.5

Our results are very similar to others', including Butler et al. (2007), with 19% of innovators (always one of the first to try new products or services) compared to 22% in our

study; 38% of early adopters and early majority combined (like to lead), compared to 39% in our study; and 40% of late majority, late adopters, and laggards combined (wait until other people have tried things before trying), compared to 32% in our study. However, if we compare these results to the reference that Rogers (2003) developed, there is a very big discrepancy; the biggest differences occur in the two extreme categories (innovators 23% and laggards 1%). Our sample consisted of many more innovators and much fewer laggards than the reference. The difference could be reflective of people's perception of themselves as more innovative than they really are.

Development of the Models of Prediction of Adoption

One of the main objectives of this research was to develop a model that predicts the behavior of landowners in implementing active management practices on their land. The process used to develop the model consisted of two steps: a factor analysis, followed by a logistic regression analysis.

Factor Analysis

Three concepts needed to be reduced through factor analysis before being entered as standalone independent variables in the logistic regression equation: the reasons for owning forest land (motivations), the relative importance of the sources of information for decision-making about forest land management, and the constraints to active forest land management.

Motivations

The measure of sampling adequacy was the first test used to assess the adequacy of the factor analysis. As shown in Table 29, the Bartlett's test of sphericity is very significant (0.000); this means correlations were significantly different from zero. The Kaiser-Meyer-Olkin measure of sampling adequacy (MSA) is 0.851, greater than the reference point of 0.8 suggested by Hair et al. (1998). Also, the Chronbach's alpha value for our motivations scales was 0.82; which is greater than 0.7, corresponding to the acceptable reliability of the measures (Hair et al. 1998). Following these tests, we extracted factors using the principal components analysis (PCA) technique

Table 29. Measure of sampling adequacy for motivation variables.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.851
Bartlett's Test of Sphericity	Approx. Chi-Square	4610.583
	df	120
	Sig.	.000

a Based on correlations

Four factors had an eigenvalue equal or greater than one, were extracted from the analysis, with the first factor having the greatest explanation power, with an eigenvalue of 4.5. All four factors combined explained a total of 53.24% of the total variance to be explained (Table 30).

Table 30. Results of the extraction of component factors for motivation variables.

Factor	Eigenvalue	% of Variance	Cumulative % of variance
1	4.566	28.536	28.536
2	1.537	9.609	38.145
3	1.4	8.749	46.894
4	1.016	6.349	53.243

Since the first factors in the unrotated component analysis factor matrix were explaining too much of the variance of the whole set of variables, we rotated the factors (Table 31) to redistribute the variance to the other factors for both simpler interpretation and more meaningful factor pattern (Hair et al. 1998). Variables such as “secondary residency” and “pass land to heirs” were poorly explained by all four factors together, with respective communalities of 0.215 and 0.212. These two last variables were not taken into account in the remainder of the analysis for they did not have a communality of 0.3 or greater required (Hair et al., 1998). The four-factor solution, in its factor matrix, contained information representing 53.24% of the total variance.

Table 31. Rotated component analysis factor matrix for motivation variables.

Variables	VARIMAX-rotated loadings				Communality
	Factor 1	Factor 2	Factor 3	Factor 4	
Scenery	.717	.118	-.015	.187	.564
Biodiversity	.659	.138	.013	.169	.482
Land investment (real estate)	.131	.630	-.116	-.041	.430
Part of home	.602	.049	.310	-.629	.857
Secondary residency	.170	-.020	.056	.424	.212
Part of farm	-.009	.031	.954	.055	.915
Privacy	.782	.046	.129	.063	.635
Pass land to heirs	.180	.235	.178	.310	.215
NTFP products	.281	.368	.358	.160	.368
Energy	.348	.326	.350	.075	.355
Timber production	.020	.747	.146	.189	.616
Hunting/fishing	.281	.255	.104	.563	.472
Recreation (other)	.611	.183	-.039	.415	.580
Retirement fund	.184	.772	-.001	.072	.635
Supplement income	.099	.684	.293	.084	.570
Lifestyle	.728	.215	.141	.129	.613
					Total
Sum of squares (eigenvalue)	3.228	2.5	1.463	1.328	8.519
Percentage of variance	20.176	15.623	9.142	8.302	53.243

Since VARIMAX is an orthogonal rotation, it minimizes the number of variables that load highly on more than one factor, which simplifies our interpretation.
We had the following variables loading 0.5 or higher on each factor (at least half of the variable is accounted for by the factor) and in a decreasing order of loading (Table 32).

Table 32. Distribution of motivation variables across the four factors.

Factor 1	Factor 2	Factor 3	Factor 4
Privacy	Retirement fund	Part of farm	Part of home (negative sign)
Lifestyle	Timber production		Hunting/fishing
Scenery	Supplement income		
Biodiversity	Land investment		
Recreation			
Part of home			

Despite the VARIMAX rotation, motivation for owning forest land as part of the home was still loading higher than 0.5 in both factor 1 and factor 4, but from the component score coefficient matrix (Table 33), the variable had a greater absolute communality on factor 4 (73%

of its variance was accounted for, by factor 4 compared to 33% accounted for by factor 1), thus, it was more appropriate to have it as part of factor 4 rather than factor 1.

Factor 1 was called "*amenity motivations*" for owning land because all of the variables that loaded significantly on it suggested amenity-related connotations. All variables that loaded significantly on factor 2 suggest economic connotations; we called it "*economic motivations*". The sole variable that loaded significantly on factor 3 was "part of farm" so we named factor 3 "*farming-related motivations*". Hunting/ fishing was loaded significantly and positively on factor 4 while "part of home" was loaded significantly but with a negative sign. These suggest that factor 4 had to do with something people would do away from their home; we labeled it "*recreation motivations.*"

Since our significance criteria for selecting factor loadings was 0.5, we excluded two additional variables, production of non-timber forest products (NTFPs) and production of energy, because none of them was loading significantly on any of the four factors. In the end, four motivation variables were eliminated from the rest of the analysis: Secondary residency, passing land to heirs, NTFPs production, and energy production.

Table 33. Component score coefficient matrix for motivation variables.

	Factors			
Variables	Factor 1	Factor 2	Factor 3	Factor 4
Scenery	.167	-.045	-.055	.058
Biodiversity	.153	-.033	-.044	.050
Land investment (real estate)	-.021	.301	-.129	-.138
Part of home	.332	.039	.120	-.730
Secondary residency	.042	-.105	.031	.275
Part of farm	-.169	-.157	.858	.127
Privacy	.304	-.119	-.008	.015
Pass land to heirs	.008	.025	.068	.185
NTFP products	.015	.083	.124	.050
Energy	.051	.076	.127	-.002
Timber production	-.128	.383	.006	.007
Hunting/fishing	.045	-.018	.029	.389
Recreation (other)	.218	-.064	-.091	.271
Retirement fund	-.041	.406	-.107	-.104
Supplement income	-.079	.275	.073	-.049
Lifestyle	.253	-.026	-.012	.038

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Sources of information

Table 34 provides the results of the measure of sampling adequacy for the set of variables about sources of information. The Bartlett test of sphericity was significant at 0.000, meaning at least two variables in the set had non-zero correlation. The Kaiser-Meyer-Olkin measure of sampling adequacy value reinforced the appropriateness of use of factor analysis for the data with its value of 0.901; much higher than the 0.8 suggested by Hair et al. (1998). Also, the Chronbach alpha's value for our source of information scale was 0.9, which is greater that the threshold stated by Hair et al., (1998) for ensuring reliability of the measures.

Table 34. Measure of sampling adequacy for sources of information variables.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.901
Bartlett's Test of Sphericity	Approx. Chi-Square	3860.755
	df	66
	Sig.	.000

a Based on correlations

Two factors were extracted from the factor analysis using PCA (Table 35). The two-factor solution explained 53.69% of the total variance.

Table 35. Results of the extraction of component factors for sources of information variables.

Factor	Eigenvalue	% of Variance	Cumulative % of variance
1	5.503	45.860	45.860
2	.940	7.830	53.690

Two variables that had the least communalities in the unrotated component factor matrix: "newsletters/magazines/newspapers" and "publications, books or pamphlets" with respectively 33% and 31% of their variance accounted for by the two-factor solution. This suggests those two variables had little in common with the others but their communalities were still higher than the threshold of 0.3, (Hair et al., 1998), thus, all variables in the set were retained for further analysis. The VARIMAX rotation allowed a more equitable distribution of the variance between the two factors (Table 36). The two-factor solution model explained 53.69% of the variance of the set of variables. In other words, the factor matrix of the two-factor solution contained

information representing 53.69% of the total variance of the set of sources of information variables included in the analysis.

Table 36. Rotated component analysis factor matrix for sources of information variables.

Variables	VARIMAX-rotated loadings		Communality
	Factor 1	Factor 2	
Publications, books or pamphlets	.422	.371	.316
Newsletters, magazines, or newspaper	.409	.409	.334
Internet/web	.270	.690	.549
Conferences or videoconferences	.619	.443	.579
Video tapes or DVDs for home viewing	.207	.817	.711
Television or radio programs	.249	.791	.688
Visiting other forest lands or field trips	.798	.235	.692
Attended workshops/short courses with support materials	.834	.200	.735
Talking with a forester or other natural resource professional	.643	.221	.462
Talking with other forest land owners	.496	.509	.505
Talking with a logging contractor	.308	.572	.422
Membership in a land owner organization	.562	.365	.450
			Total
Sum of squares (eigenvalue)	3.309	3.134	6.443
Percentage of variance	27.577	26.114	53.69

Five variables loaded significantly on the first factor while another five also loaded on the second factor. Two variables, “Publications, books or pamphlets” and Newsletters/magazines/ newspapers did not load significantly on either of the two factors; thus, they were not taken into account in further analysis. The summary of the variables loading significantly on either of the two factors is shown in Table 37, in decreasing order of loading.

Table 37. Distribution of source of information variables across the two factors extracted.

Factor 1	Factor 2
Workshop/shortcourses	Video tapes/DVDs
Fieldtrips	Radio/ TV
Natural resource professionals interaction	Internet/web
Conferences	Interaction with logging contractor
Membership in a landowner organization	Interaction with other forest landowners

Since no variable loaded significantly on both factors at once, we did not need to use the component score coefficient matrix. The variables that loaded on factor 1, except for membership in a landowner organization suggested direct interaction with professional people in

the field. We then labeled factor 1: "*direct professional information*". On the other hand, variables that loaded on factor 2 suggested a more distant approach, though some of the sources of information themselves still come from professionals; they also suggested that the individual learns by him/herself. We labeled factor 2 "*self-learning*" source of information.

Constraints to Active Forest Management

Despite the many incentives offered to NIPF owners to actively manage their forest through financial, technical or educational assistance, a number of factors may decrease the willingness of landowners to manage their forest land actively. In this analysis, we grouped the 20 original constraints to forest management variables into four, easier to handle ones through PCA. The Bartlett's test of sphericity was extremely significant (Table 38), which means there were non-zero correlations among at least two of the variables in the set. The Keiser-Meyer-Olkin measure of sampling adequacy value was much higher than the requirement of 0.8 needed for the data to be adequately analyzed with factor analysis. Also, the Chronbach alpha's value of our constraints scale was of 0.89, which is greater than the threshold stated by Hair et al. (1998) for ensuring the reliability of the measures.

Table 38. Measure of sampling adequacy for constraints variables.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.918
Bartlett's Test of Sphericity	Approx. Chi-Square	6383.794
	df	190
	Sig.	.000

a Based on correlations

Though one factor had an eigenvalue less than one, it was included because its eigenvalue was very close to one (0.996). Four factors were then extracted from the set of variables. The four-factor solution explained 52% of the total variance (Table 39).

Table 39. Results of the extraction of component factors for constraints variables.

Factor	Eigenvalue	% of Variance	Cumulative % of variance
1	6.736	33.678	33.678
2	1.535	7.674	41.352
3	1.129	5.643	46.995
4	.996	4.981	51.976

All variables in the set had higher communalities than the 0.3 in the unrotated component analysis factor matrix; thus, they all were included in the rest of the analysis; however, several variables, such as “insufficient time” and “insufficient labor” loaded significantly on more than one factor; this fact suggests a necessity for rotating the factors using VARIMAX. Table 40 shows the rotated component analysis factor matrix.

Table 40. Rotated component analysis factor matrix for constraints variables.

Variables	VARIMAX-rotated loadings				Communality
	Factor 1	Factor 2	Factor 3	Factor 4	
Dealing with endangered species	.499	.136	.302	.041	.360
Fear of lawsuits	.507	.148	.416	.020	.453
Regulations that restrict harvests	.450	.291	.446	-.032	.487
Insufficient profit from management or harvest	.104	.546	.611	.075	.687
No local market for the forest products I wanted to sell	.222	.510	.450	-.026	.513
High property taxes	.334	-.071	.730	.146	.671
Not enough financial means to afford management costs	.179	.096	.573	.438	.562
Development of nearby lands	.640	.235	.199	.157	.529
Trespassing, poaching and dumping	.809	-.010	.126	.129	.687
People stealing my trees	.508	.172	.242	.129	.363
Not enough time to allocate to forest management tasks.	.193	.160	.049	.849	.786
Not enough labor to allocate to forest management tasks.	.130	.294	.166	.815	.795
Too small acreage to make management worthwhile	.071	.551	-.132	.257	.392
Soil (poor soil or wet soil)	.388	.433	.092	.242	.406
Damage or noise from motorized vehicles	.498	.397	.044	.118	.422
Concerns about environmental damages by harvesting	.522	.463	.016	.089	.495
Neighbors complain about forest management	.462	.445	.094	.107	.431
Difficulty finding professional forestry advice	.311	.494	.201	.127	.398
Managing my land is not cost effective	-.016	.537	.269	.352	.485
Difficulty finding logger or other service provider	.276	.600	.171	.093	.474
					Total
Sum of squares (eigenvalue)	3.351	2.849	2.223	1.973	10.396
Percentage of variance	16.754	14.246	11.113	9.863	51.976

Varimax rotation helped simplify the variables that previously loaded on more than one factor. Five variables (endangered species, damage/noise from motorized vehicle, neighbors’ complaints, harvesting regulations, and poor soil) did not have significant loading on any of the four factors, thus they were eliminated in the subsequent analysis. Five variables loaded significantly on the first factor, four on the second, three on the third and two on the last factor. In decreasing order of loading, variables were classified as shown in Table 41.

Table 41. Distribution of the constraints variables across the four factors extracted.

Factor 1	Factor 2	Factor 3	Factor 4
Trespassing/poaching/dumping	Difficulty finding logger	Property taxes	Insufficient time
Development of nearby land	Small land	Insufficient profit	Insufficient labor
Harvesting damages	Not cost-effective	Cannot afford management	
Tree theft	No market for products		
Fear of lawsuit			

Given that all variables in factor 1 suggested constraints caused by other humans, we labeled it "*human-related constraints*". Variables that loaded significantly on factor 2 suggested a lack of cost-effectiveness because of the small scale of the property. Factor 2 was then labeled "*scale-related constraints*". Variables that loaded on factor 3 were all financially related, it was labeled "*financial constraints*". Time and labor issues were the only variables that loaded on factor 4; it was labeled "*time/labor constraints*."

Validation of the Factor Analysis

We used the split sample method to validate the results of the factor analysis. The original sample was randomly divided into two equal samples, and then, we re-estimated the factor models for comparability, both between the two smaller samples, and between the smaller samples and the original sample. The validation results for the motivation variables are shown in Table 42.

Table 42. Validation of the factor-solution for the motivation set of variables.

	Sample 1				Sample 2			
	VARIMAX-rotated loadings				VARIMAX-rotated loadings			
Variables	Factor1	Factor 2	Factor 3	Factor 4	Factor1	Factor 2	Factor 3	Factor 4
Scenery	.684	.091	-.026	.138	.753	.146	.031	.173
Biodiversity	.614	.154	.006	.166	.715	.127	.039	.113
Land investment (real estate)	.041	.633	-.129	-.003	.212	.625	-.097	-.099
Part of home	.521	.025	.329	-.706	.605	.052	.238	-.643
Secondary residency	.218	.019	.061	.424	.172	-.035	.074	.405
Part of farm	.009	.084	.962	.063	-.025	.000	.935	-.043
Privacy	.810	-.038	.091	.019	.752	.138	.187	.005
Pass land to heirs	.153	.251	.111	.186	.233	.201	.278	.390
NTFP products	.240	.381	.312	.120	.330	.350	.424	.143
Energy	.404	.375	.236	-.124	.298	.264	.451	.184
Timber production	.080	.746	.106	.113	-.016	.743	.206	.209
Hunting/fishing	.347	.199	.222	.504	.268	.388	.018	.492
Recreation	.659	.170	.013	.359	.607	.228	-.065	.381
Retirement fund	.111	.779	-.010	.058	.259	.765	.020	.037
Supplement income	.119	.694	.292	.019	.081	.673	.299	.095
Lifestyle	.739	.261	.147	-.005	.728	.153	.153	.187

Table 43 provides the comparisons of the different variables that loaded significantly across all factors for the three samples used for the validation of the factor-solution.

Table 43. Comparison of variables loading on each factor between the three samples.

	Sample 1	Sample 2	Total sample (model)
Factor 1	Privacy	Scenery	Privacy
	Lifestyle	Privacy	Lifestyle
	Scenery	Lifestyle	Scenery
	Recreation	Biodiversity	Biodiversity
	Biodiversity	Recreation	Recreation
Factor 2	Retirement fund	Retirement fund	Retirement fund
	Timber production	Timber production	Timber production
	Supplement income	Supplement income	Supplement income
	Land investment	Land investment	Land investment
Factor 3	Part of farm	Part of farm	Part of farm
Factor 4	Part of home	Part of home	Part of home
	Hunting/fishing		Hunting/fishing

For the three first factors, all variables that loaded on each factor were the same for the three models; the only difference was the order of importance of their loadings, they were swapped. For factor 4, the model from the total sample and from sample 1 had the same variables loading on them, and in the same order of importance of their loadings; but it was not the case for sample 2 because “hunting/fishing” did not load significantly on any factor, with a loading of 0.492 (very close to 0.5). From these comparisons, we can say that our factor solution was relatively stable. The validation results for the sources of information variables are shown in Table 44; though their order of loading are swapped, four variables loaded significantly on factor 1 across all three samples, “interaction with professionals” also loaded significantly on factor 1 for both sample 1 and the total sample but not for sample 2 where it failed to qualify, with a loading of 0.486 (which is very close to the 0.5 threshold).

Table 44. Validation of the factor-solution model for the sources of information variables.

Variables	Sample 1 VARIMAX-rotated loading Factor 1	Sample 1 VARIMAX-rotated loading Factor 2	Sample 2 VARIMAX-rotated loadings Factor 1	Sample 2 VARIMAX-rotated loadings Factor 2
Publications, books or pamphlets	.175	.435	.161	.477
Newsletters, magazines, or newspaper	.176	.451	.183	.486
Internet/web	.294	.706	.306	.611
Conferences or videoconferences	.554	.512	.678	.402
Video tapes or DVDs for home viewing	.274	.779	.190	.783
Television or radio programs	.329	.719	.249	.762
Visiting other forest lands or field trips	.818	.156	.613	.471
Attended workshops/short courses with support materials	.759	.284	.852	.207
Talking with a forester or other natural resource professional	.576	.280	.486	.391
Talking with other forest land owners	.299	.653	.268	.742
Talking with a logging contractor	.260	.535	.199	.710
Membership in a land owner organization	.659	.168	.533	.467

Table 45 shows that five variables loaded significantly on factor 2 for all three samples; two of them (Video tapes/DVDs) loaded very highly across the three models and the rest of the five swapped from one model to another. The comparisons of the models from the three samples suggested that our results are stable, at least within our sample; and can be used for subsequent analyses.

Table 45. Comparison of variables loading on each factor between the three samples

Factor 1

Sample 1	Sample 2	Total sample (model)
Fieldtrips	Workshop/shortcourses	Workshop/shortcourses
Workshop/shortcourses	Conferences	Fieldtrips
Landowner organization	Fieldtrips	Interaction with professionals
Interaction with professionals	Landowner organization	Conferences
Conferences		Landowner organization

Factor 2

Sample 1	Sample 2	Total sample (model)
Video tapes/DVDs	Video tapes/DVDs	Video tapes/DVDs
TV/radio programs	TV/radio programs	Radio/ TV
Internet/web	Interaction with other forest owners	Internet/web
Interaction with other forest owners	Interaction with logging contractor	Interaction with logging contractor
Interaction with logging contractor	Internet/web	Interaction with other forest owners

The validation results for the constraints set of variables are shown in Table 46, using the two samples we selected randomly.

Table 46. Validation of the factor-solution model for the constraints set of variables.

	Sample 1				Sample 2			
	VARIMAX-rotated loadings				VARIMAX-rotated loadings			
Variables	Fac.1	Fac. 2	Fac. 3	Fac. 4	Fac.1	Fac. 2	Fac. 3	Fac. 4
Dealing with endangered species	.120	.418	.076	.082	.444	.451	-.019	.092
Fear of lawsuits	.654	.151	.057	.154	.536	.484	.063	.034
Regulations that restrict harvests	.308	.433	-.009	.116	.369	.492	.094	.058
Insufficient profit from management or harvest	-.034	.252	.639	.407	.007	.342	.696	.252
No local market for the forest products	.312	.608	-.074	.231	.132	.614	.307	.132
High property taxes	-.003	-.042	.551	.612	.291	.071	.560	.185
Cannot afford management costs	.192	.159	.698	.379	.159	.203	.549	.271
Development of nearby lands	.526	.360	.274	.130	.637	.262	.236	.051
Trespassing, poaching and dumping	.691	.191	.140	.055	.827	.001	.115	.073
People stealing my trees	.467	.355	.126	.117	.466	.253	.106	.143
Not enough time for forest management tasks.	.111	.173	.109	.837	.211	.071	.038	.883
Not enough labor for management tasks.	.212	.161	.212	.820	.106	.161	.213	.848
Too small acreage	.426	.426	-.025	-.093	.066	.519	.230	.302
Soil (poor soil or wet soil)	.498	.277	.280	-.004	.401	.357	.202	.341
Damage or noise from motorized vehicles	.480	.330	.205	-.049	.426	.221	.308	.145
Environmental damages by harvesting equipt.	.501	.434	.245	-.110	.641	.031	.433	.030
Neighbors complain about forest management	.311	.393	.198	-.016	.414	.264	.343	.147
Difficulty finding professional forestry advice	.405	.149	.169	.168	.282	.127	.433	.093
Managing my land is not cost effective	-.060	.581	.342	.408	-.066	.508	.288	.372
Difficulty finding logger or other service provider	.283	.621	.149	.036	.105	.729	.188	.145

Table 47 provides a list of the variables that loaded on each of the four factors for the constraints to active forest management and across the three samples for validation of the model.

Table 47. Comparison of variables loading on each factor between the three samples

	Sample 1	Sample 2	Total sample (model)
Factor 1	Trespassing/poaching/dumping	Trespassing/poaching/dumping	Trespassing/poaching/dumping
	Fear of lawsuits	Damages by harvesting equipments	Development of nearby land
	Development of nearby lands	Development of nearby lands	Harvesting damages
	Damages by harvesting equipments	Fear of lawsuits	Tree theft
Factor 2	Difficulty finding loggers	Difficulty finding loggers	Difficulty finding logger
	No market	No market	Small land
	Management not cost-effective	Small land	Not cost-effective
		Management not cost-effective	No market for products

Factor 3	Cannot afford management cost	Insufficient profit	High property taxes
	Insufficient profit	High property taxes	Insufficient profit
	High property taxes	Cannot afford management cost	Cannot afford management
Factor 4	Insufficient time	Insufficient time	Insufficient time
	Insufficient labor	Insufficient labor	Insufficient labor

For factor 1, four variables loaded significantly across all three samples; "trespassing/poaching/dumping" had the highest load factor across all three samples. However, the model derived from the total sample size had an additional variable (tree theft). By looking closer, we realize that this variable had very similar loadings (0.467, 0.466 and 0.508 respectively for sample 1, sample 2 and the total sample). Though "tree theft" loaded significantly on factor 1 for the total sample, its loadings remained relatively constant across the three models; which suggests a stability of the results.

For factor 2, models from sample 2 and from the total sample had the same list of four variables loading significantly on the factor though they were not in the same order of importance. Also, three of those same variables loaded significantly on factor 2 in sample 1; however, "small land" was not significant in sample 1, it had a loading of 0.426. Factors 3 and 4 had the same variables loading significantly on them, across all three samples.

Despite the swapping and the small differences in the variables loading for some of the factors in our models, we can say that all three models are stable at least within the sample of our study population; thus, the results can be used for further analysis after computation of the factor scores.

Computation of the Factor Scores

After validation of the factor analysis, each extracted factor was used as a stand alone variable using the Anderson-Rubin method for computing the factor scores (to ensure the orthogonality of the scores). Once factor scores were computed, each factor was taken into account in the logistic regression analysis for developing the models predicting the adoption of SFM practices. The following section deals with the development of the model.

Logistic regression

We were interested in knowing whether a given NIPF owner would likely be an adopter or a non-adopter of a given set of practices. For its practicality (minimum requirements, especially in terms of multivariate normality and homoscedasticity), logistic regression was the chosen method for this analysis.

Also, to test the validity of our models, we split our total sample into two, the first sample included 55% of the total sample; we developed the model from that first part of the sample. The second sample consisted of the remaining 45%, which was used to assess the prediction accuracy of the model developed from the first sample. Table 48 shows the variables included in the analysis.

Table 48. List of variables used in the logistic regression analysis.

Dependent variables	
Overall practices	Dummy
Harvesting practices	Dummy
Wildlife management practices	Dummy
Woodland management practices	Dummy
BMP practices	Dummy
Conservation easements	Dummy
Use of technical assistance	Dummy
Use of a written management plan	Dummy
Use of financial assistance	Dummy

Independent variables	
Frequency of attendance of educational programs	Continuous
Use of technical assistance	Dummy
Use of a written management plan	Dummy
Use of financial assistance	Dummy
Acreage (acres)	Continuous
Number of tracts owned	Continuous
Length of ownership (years)	Continuous
Distance between home and forest (miles)	Continuous
Age	Continuous
Level of education	Categorical
Income from forest-related activities (% household income)	Categorical
Household income ($)	Categorical
FAC1_1 (amenity motivations)	Continuous
FAC2_1 (economic motivations)	Continuous
FAC3_1 (farming-related motivations)	Continuous
FAC4_1 (recreation motivations)	Continuous
FAC1_2 (direct professional information)	Continuous
FAC2_2 (self-learning sources of information)	Continuous
FAC1_3 (human-related constraints)	Continuous
FAC2_3 (scale-related constraints)	Continuous
FAC3_3 (financial constraints)	Continuous
FAC4_3 (time/labor constraints)	Continuous

Although logistic regression is more robust than many other types of multivariate analysis, there must be at least twenty observations per group for the model to be valid. In our case, the groups consisted of adopters and non-adopters (Hair et al., 1998).

Harvesting practices

The total number of cases used for both the development of the model and the validation was 304 (167 used to develop the model and 137 for validation). These numbers have respectively a 7/1 and 6/1 ratio of the number of observations per group to the number of independent variables in the analysis. The ratio meets the minimum 5/1 ratio suggested by Hair et al. (1998) and the number of observations per group was much higher than the 20 observations per group requirement data for the meaningfulness of the analysis, with 33 adopters and 271 non-adopters. The model development for harvesting practices adoption is shown in Table 49.

Table 49. Results of the logit model development for harvesting practices adoption.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	102.440			
Cox & Snell R Square	.068	From base model	11.741	.001
Nagelkerke R Square	.137	From prior step	11.741	.001

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	1.765	.534	10.919	1	.001	5.842
Constant	1.153	.331	12.117	1	.000	3.167

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	0	18	.0	0	15	.0	33
Group 1: adopters	0	149	100.0	0	122	100.0	271
Overall percentage			89.2			89.1	
TOTAL	0	167		0	137		304

a Selected cases approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

We used the Wald forward Stepwise Method for entering the variables into the model; in this case here, the iteration process stopped at step 1, leaving only one independent variable (technical assistance) showing significance in explaining the adoption of harvesting practices. The Chi square testing the change in the -2 log likelihood from that of the base model was highly significant, which means that the decrease in the error terms (-2 log likelihood) was significantly

different from zero. We could also see that the Wald statistics were highly significant, meaning that both the constant and the coefficient for technical assistance in the model were significantly different from zero.

The Nagelkerke R square is 0.137, which suggested that 13.7% of the variance of the odds ratio in the adoption of harvesting practices was accounted for by technical assistance. The positive coefficient of technical assistance (1.765) means that an individual using technical assistance is more likely to adopt sustainable harvesting practices than one who does not.

The classification matrix showed that of the 167 observations used to develop the model, 149 (89.2%) were correctly classified. When applied to the 45% holdout sample, the developed model correctly classified 89.1% of the 137 observations. This result validated the stability of our model, thus its generalizability, at least across the total sample of our study population. The technical assistance coefficient of 1.765 translates into an additional odds ratio of 5.84, corresponding to a greater probability of adoption of harvesting practices.

Wildlife Management Practices

The numbers of observations used for this analysis were 128 and 120, respectively for developing the model and for validating it; both the analysis sample and the holdout sample have a ratio of observations to number of independent variables that meet the 5/1 requirement. Also, there were 48 non-adopters and 200 adopters, which means the 20 cases per group requirement was met. Results of the development of the model are displayed in Table 50.

Table 50. Results of logit model development for adoption of wildlife management practices.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	114.719			
Cox & Snell R Square	.126	From base model	17.171	.001
Nagelkerke R Square	.195	From prior step	5.393	.020

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Distance home-forest	-.006	.006	1.035	1	.309	.994
Written management plan	1.245	.551	5.107	1	.024	3.472
Time/labor constraints	.733	.286	6.568	1	.010	2.082
Constant	1.096	.283	14.968	1	.000	2.992

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	4	23	14.8	3	18	14.3	48
Group 1: adopters	2	99	98.0	2	97	98.0	200
Overall percentage			80.5			83.3	
TOTAL	6	122		5	115		248

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	11.240	8	.188

Three variables, including distance between home and any of the NIPF owner's tracts of forest land, the use of a written management plan, and time/labor constraints were the only significant variables identified. The goodness of fit measures suggests that: first, there was very significant improvement in the reduction of the error term from the base model to the final model, as indicated by the Chi-square value of 17.17, significant at 0.001, for the change in -2 log likelihood. Second, the Nagelkerke R square suggests that 19.5% of the variance in the odds ratio of adoption of wildlife practices was accounted for by the three variables included in the model.

The change in the distance between an individual's home and forest land would not have had any effect on his/her likelihood of adopting wildlife management practices because its coefficient did not differ from zero (the Wald Statistic was not significant). The other two

variables in the model had positive coefficients; with the coefficient of written management plan corresponding to an additional 3.47 in odds ratio for adoption for each unit increase in the values of the variable; this means that the only fact of using a written management plan would bring the probability of an owner to adopt wildlife management practices to three times the probability for him/her not to adopt. The odds ratio corresponding to the time/labor constraints coefficient was 2.08; which was less than it was for written management plan, but still, it means that an increase in one unit in the perception of the seriousness of the limitation in time/labor an owner would double his/her probability of adopting wildlife management compared to his/her probability of not adopting. The positive coefficient for the use of a written management plan was straightforward because it is logical and expected that an individual having and using a written management plan would likely be an adopter of sustainable forestry practices. However, it seems a little bit surprising to see a positive coefficient attached to time/labor constraints; indeed, our results suggests that people having more time/labor constraints in managing their forest land are more likely to be adopters compared to those who did not have (or had less). A possible explanation is that these people fixed themselves higher objectives to attain (either in the number of practices or in their quality and intensity) that time/labor became a major issue for them to reach their objectives.

The developed model classified correctly 80.5% of the sample from which the model was developed, and 83.3% of the cases for the holdout sample. The Hosmer and Lemeshow Chi-square tested whether the difference between the predicted and the actual classifications of the cases in the analysis sample was significant or not. The Chi-square was significant at a level of 0.188, which was much higher than our significance level of 0.10, thus, we could reject the null hypothesis. Thus, the predicted classification and the actual classification are the same; which means our model is stable across the total sample of our study population.

Woodland Management Practices

We used 230 cases for developing the model and 189 for validating it. These numbers meet the requirements both for the number of cases for each group (37 non-adopters and 382 adopters) and the 5/1 ratio (respectively 10/1 and 8/1). The logistic regression results are shown in Table 51.

Table 51. Results of the logit model development for adoption of woodland management practices.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	109.310			
Cox & Snell R Square	.206	From base model	52.992	.000
Nagelkerke R Square	.407	From prior step	2.755	.097

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Length of ownership	-.055	.019	8.400	1	.004	.946
Technical assistance	2.236	.618	13.085	1	.000	9.351
Amenity motivations	.562	.212	7.051	1	.008	1.755
Economic motivations	.500	.255	3.854	1	.050	1.649
Wilderness/gamingmotivations	.559	.279	4.016	1	.045	1.749
Constant	2.870	.620	21.403	1	.000	17.632

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	12	14	46.2	1	10	9.1	37
Group 1: adopters	3	201	98.5	7	171	96.1	382
Overall percentage			92.6			91.0	
TOTAL	15	215		8	181		419

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	4.790	8	.780

The analysis entered five independent variables in the model. The change in the error term (-2 log likelihood) dropped very significantly from the base model to the final model (Chi-square of 52.99, significant at 0.000), and from the model prior to the final model to the final model (Chi square of 2.755, significant at 0.09). This suggests the final model was significantly better compared to the base model and the intermediate models. The Nagelkerke R square suggests that 40.7% of the variance in the odds ratio for a person to adopt woodland management practices was accounted for by the five variables entered in the model.

All variables entered in the final model had coefficients significantly different from zero; the Wald Statistic significance ranged from 0.004 to 0.10. Also, all variables had positive

coefficients except for length ownership (-0.055), suggesting that the longer people owned their land, the less likely they were adopters of woodland management practices. In terms of odds ratio, this means that each additional year an owner owns his/her land would translated into an odd ratio of 0.94, meaning that the owner has more probability not to adopt woodland management practices compared to his/her probability to adopt. The other odd ratios for adoption, corresponding to the other coefficients were respectively 9.35, 1.75, 1.64 and 1.74 for technical assistance, amenity motivations, economic motivations, and recreation motivations. These numbers suggest that technical assistance was the strongest predictor for adoption, and the three motivation variables were similar, and with less degree.

The classification matrix shows that the developed model allowed us to classify 92.6% of the observations in the analysis sample correctly. The Hosmer and Lemeshow Chi-square were significant at 0.78, which means the predicted and the actual classifications were not significantly different from one another. The classification matrix also suggests that the developed model classified 91% of the cases when applied to the 45% holdout sample. These results provide us confidence about the stability of the model across our sample of the study population.

Adoption of Best Management Practices

Best management practices are practices related to minimizing harvesting damages and protecting resource quality, including soil and water. All cases used for this analysis were taken from respondents that had harvested at least once in the past eleven years. We had 195 cases for developing the model and 158 for validating it (respectively a ratio of 9/1 and 7/1). Both these numbers meet the requirement for each group (73 non-adopters and 280 adopters). Results of the analysis are presented in Table 52.

Table 52. Results of the logit model development for adoption of best management practices.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	165.996			
Cox & Snell R Square	.126	From base model	26.356	.000
Nagelkerke R Square	.202	From prior step	5.855	.016

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Financial assistance	2.457	.748	10.785	1	.001	11.666
Human-related constraints	.534	.228	5.511	1	.019	1.707
Constant	.915	.200	20.914	1	.000	2.496

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	2	36	5.3	1	34	2.9	73
Group 1: adopters	0	157	100.0	2	121	98.4	280
Overall percentage			81.5			77.2	
TOTAL	2	193		3	155		353

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	4.770	8	.782

The model entered two significant variables. The change in the error term was significant from both the base model (Chi-square of 26.35 at 0.000) and the first step (Chi-square of 5.855 at 0.016). The Nagelkerke R square value of 0.202 suggested that 20.2% of the variance in the likelihood of a NIPF owner to adopt BMP practices was accounted for by the two variables entered in the model.

Both variables entered had coefficients significantly different from zero as the Wald Statistic attests, with 10.78 at 0.001 and 5.51 at 0.02 respectively for financial assistance and human-related constraints. These results mean that a change in any of the two variables would have an effect on the probability of an individual to adopt BMP practices. Both variables had positive coefficients and the corresponding odds ratios were 11.6 and 1.7 respectively for financial assistance and human-related motivations. These numbers suggest that owners using

financial assistance and/or who had more human-related constraints were more likely to adopt BMPs, which seems illogical. We should not forget that several variables loaded significantly on this factor and that “trespassing/ poaching/dumping” loaded the highest (with 0.809). A possible explanation is that harvesting is always related to road building, which implies easier access to the property, including trespassing, illegal hunting or dumping.

The classification matrix showed that the model correctly classified 81.5% of all cases used for developing the model. The Hosmer and Lemeshow value was significant at 0.782, which means that the predicted and the actual classifications were not significantly different from each other, suggesting the appropriateness of the model. Also, the developed model allowed the correct classification of 77.2% of the cases from the holdout sample, meaning that the model accurately predicted BMP adoption across the total sample of our study population.

Conservation easements

Conservation easements are land preservation agreements between landowners and an institution or organization for protecting the land. There are different types of restrictions about the types of activities and/or use that can be done on the land when it is put under an easement, but ultimately, the goal is sustainable conservation of the resources. This analysis used 247 cases and 200 others for validation of the developed model for respective ratios of 11/1 and 9/1; also, there are 414 non-adopters and 33 adopters. The results of the model development are shown in Table 53.

Table 53. Results of the logit model development for conservation easements adoption.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	126.089			
Cox & Snell R Square	.031	From base model	7.879	.019
Nagelkerke R Square	.075	From prior step	3.632	.057

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Self-learning information	-.443	.228	3.759	1	.053	.642
Scale-related constraints	-.509	.269	3.589	1	.058	.601
Constant	-2.514	.254	98.186	1	.000	.081

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	228	0	100.0	186	0	100.0	414
Group 1: adopters	19	0	.0	14	0	.0	33
Overall percentage			92.3			93.0	
TOTAL	247	0		200	0		447

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	3.007	8	.934

The iteration process stopped at step two; therefore, two variables were entered in the model: “Self-learning information” and “scale-related” constraints. The measures of the goodness of fit of the model suggested that first, the decrease in the -2 log likelihood value was significant both from the base model and from the first step of the iteration to the final model with a Chi-square significance of respectively 0.019 and 0.057 (test significance at the 0.1 level). Second, only 7.5% of the variance in the odds ratio of a NIPF owner to adopt any type of conservation easement was accounted for by the two variables in the model.

All coefficients in the model were negative, including the constant. With all of them significantly different from zero, as the Wald Statistic shows (significance ranging from 0.000 to 0.058), these negative signs mean that the more an owner perceives the usefulness (suggesting the use) of self-learning information as important, the less likely he/she would adopt conservation easement practices. The odds ratios corresponding to the predictors were 0.64 and

0.6 respectively for self-learning information, and scale-related limitations. These numbers suggest that a unit increase in either of the two variables would add the probability for non adoption to about twice the probability of adoption of conservation easement programs.

In fact, the more an individual learns about conservation easements by himself through different means such as books, friends, family, etc. and without consulting, or considering professional foresters' advices, he/she would come across information suggesting that putting his/her land under easement would restrict his/her control over his/her own land for the following 10, 20 or 30 years. This fact would be very deterrent of any original intent of implementing the land under easement because it is related to the perceived lack of control over the behavior (Ajzen, 1991). Likewise, the more constraints an individual faces regarding the small scale of his/her resources, the less likely he/she would be adopting conservation easement practices. These facts make sense because if an owner only owns a small land and he/she put it under conservation easement; he/she would not have much flexibility remaining when it comes to what he/she could do on the land for a long period of time (Roper Public Affairs and Media, 2007).

The developed model correctly classified 92.3% of the cases from the analysis sample. With a Hosmer and Lemeshow Chi-square significant at 0.934, this means that the predicted and the actual classifications were not significantly different from each other; suggesting the accuracy of the developed model. Also, the model correctly classified 93% of all cases from the holdout sample; this suggests a very high prediction accuracy of the model.

Written Management Plan

Having and using a written management plan has always been considered as one of the key practices and one of the precursors of other types of practices for NIPF owners despite that fact, only a small percentage of NIPF owners have and/or use a written management plan (Birch, 1996; Butler and Leatherberry, 2004; Best, 2004; Measells et al., 2005). This analysis tries to determine what lead NIPF owners to adopt a written management plan. The analysis sample included 248 cases while the validation sample had 200, with respective ratios of 11/1 and 9/1; also, there were 319 non-adopters and 129 adopters; both requirements were met. The results of the logistic regression for management plan adoption are shown in Table 54.

Table 54. Results of the logit model development for written management plan adoption.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	248.833			
Cox & Snell R Square	.183	From base model	49.977	.000
Nagelkerke R Square	.261	From prior step	6.393	.011

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	1.604	.364	19.457	1	.000	4.974
Wilderness/gamingmotivations	.387	.156	6.150	1	.013	1.473
Direct prof. information	.708	.205	11.916	1	.001	2.030
Constant	-2.239	.333	45.068	1	.000	.107

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	160	16	90.9	127	16	88.8	319
Group 1: adopters	45	27	37.5	45	12	21.1	129
Overall percentage			75.4			69.5	
TOTAL	205	43		172	38		448

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	11.503	8	.175

The iteration stopped after four variables were entered, including technical assistance, recreation motivations and direct professional source of information.

The decrease in the -2 log likelihood was very significant either from the base model (Chi-square of 49.977 significant at 0.000) or from the previous step of iteration (Chi-square of 6.393, significant at 0.011). The Nagelkerke R square value of 0.261 suggests that 26.1% of the variance in the likelihood of a given NIPF owner to adopt a written management plan was accounted for by the four variables in the model.

All variables entered had coefficients significantly different from zero, meaning that changes in them would have an effect on the likelihood of a person to adopt written management plan. Also, all of the variables had positive coefficients, suggesting that any increase in any of them would translate into an increase in the probability of an individual to adopt (have and use) a written management plan. Technical assistance had the greatest effect on the probability of

adoption of a written management plan; with a coefficient of 1.604, which translates to 4.97 in terms of odds ratio (i.e. the fact of using technical assistance alone, by controlling all other variables, would bring the probability of adoption of a written management plan to five times the probability of its non adoption). Direct professional sources of information had a coefficient of 0.708, which translates into 2.02; and recreation motivations, with a coefficient of 0.387 would bring an odd ratio for adoption of 1.47. In terms of the strength of the variables, we can then rank written management plan as strongest, followed by direct professional information, and wilderness/gaming motivations as weakest.

The model correctly classified 75.4% of the cases in the analysis sample. The Hosmer and Lemeshow significance was 0.175, meaning that the predicted and the actual classifications were not significantly different from one another. Also, the developed model classified 69.5% of all cases from the validation sample. These two results combined suggest the developed model was reasonably accurate, at least across the total sample of our study population.

Technical Assistance

Along with financial assistance, the use of a written management plan and educational programs, technical assistance was the third type of assistance that Cooperative Extension delivers for NIPF owners. Although technical assistance and financial assistance cannot be considered as sustainable practices by themselves, their use is considered to be an indicator leading to adoption of practices. For this reason, it was interesting to determine which factors explained their use. We used 248 cases for developing the model in this analysis, and 200 others for validating it; the respective ratios were 11/1 and 9/1; and with 179 non-adopters and 269 adopters, both requirements are met. The results for the development of the model are shown in Table 55.

Table 55. Results of the logit model development for use of technical assistance.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	289.505			
Cox & Snell R Square	.173	From base model	47.149	.000
Nagelkerke R Square	.233	From prior step	2.921	.087

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
% household income from forest	-.019	.011	2.852	1	.091	.981
Household income	.255	.137	3.453	1	.063	1.290
Economic motivations	.538	.149	13.083	1	.000	1.712
Written management plan	1.728	.370	21.755	1	.000	5.627
Constant	-.830	.468	3.144	1	.076	.436

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	63	40	61.2	50	26	65.8	179
Group 1: adopters	32	113	77.9	29	95	76.6	269
Overall percentage			71.0			72.5	
TOTAL	95	153		79	121		448

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	13.030	8	.111

The model entered four significant variables: percentage of income generated from forest-related activities, household income, economic motivations, and the use of a written management plan. The changes in -2 log likelihood were significant at each step and the Chi-square value of the difference between the base model was very significant. The Nagelkerke R square suggested that 23.3% of the variance in the likelihood for a person to use technical assistance was explained by the four variables in the model. All four variables entered in the model had coefficients significantly different from zero, which means that a change in any of them would have an effect on the likelihood of a person to use technical assistance. Three variables had positive coefficients; use of a written management plan had the most effect on the probability of an individual to use technical assistance with a coefficient of 1.728 and a corresponding odds ratio of 5.62; followed by “economic motivations”, with a coefficient of

0.538 (odds ratio of 1.71), and household income came last with a coefficient of 0.255 and an odds ratio of 1.29. The percentage of household income generated from forest-related activities had a negative coefficient, this suggested that the more proportion of income an individual earned from forest-related activities, the less likely he/she will use technical assistance. An explanation of this could be that for an individual to get a substantial amount of income from forest-related activities, he/she must have mastered management techniques and practices for a long time; thus already had the knowledge and the know-how about forest management. Therefore, he/she should be less likely need technical assistance as compared to others who were just starting to manage their land. However, the coefficient is -0.019, which is very close to zero; perhaps the reason why it was significantly different from zero was the simple fact of the large sample size used for developing the model.

The classification matrix shows that the developed model correctly classified 71% of the 248 cases in the analysis sample. The Hosmer and Lemeshow test shows that the predicted and the actual classification of the cases from the analysis sample were not significantly different (with a Chi-square of 13.03 significant at 0.111). This suggests that the developed model was accurate in predicting the use of technical assistance. When applied to classify the 200 cases from the holdout sample, the model correctly classified 72.5% of them; a fact that reinforced the appropriateness of the model developed in predicting the probability of a given owner to use technical assistance.

Financial Assistance

As stated earlier, the use of financial assistance is not a practice by itself; rather, it is a good indicator of the direction where a given landowner is going in his/her management of the land. Two hundred forty eight cases were used to develop the model and 200 others for validating it; the respective ratios are 11/1 and 9/1; and with 315 non-adopters and 133 adopters, both requirements are met. The results of the development of the model are displayed in Table 56.

Table 56. Results of the logit model development for use of financial assistance.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	233.204			
Cox & Snell R Square	.209	From base model	58.139	.000
Nagelkerke R Square	.302	From prior step	3.556	.059

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Educational programs	.205	.054	14.427	1	.000	1.228
% household income from forest	.051	.017	8.555	1	.003	1.052
Household income	.303	.162	3.480	1	.062	1.353
Direct prof. information	.492	.232	4.517	1	.034	1.636
Constant	-3.029	.618	24.034	1	.000	.048

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	167	13	92.8	127	8	94.1	315
Group 1: adopters	38	30	44.1	47	18	27.7	133
Overall percentage			79.4			72.5	
TOTAL	205	43		174	26		448

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	10.412	8	.237

The final model involved four variables including educational programs, percentage of household income generated from forest-related activities, total household income, and direct professional source of information. The reduction of the error term was very significant from the baseline, with a Chi-square significant at 0.000; and 0.059 between the third step and the final model. The developed model was explaining 30.2% of the variance in the probability of a given NIPF owner to use financial assistance. All the variables had coefficients significantly different from zero. Information obtained directly from professionals was the strongest predictor, followed by household income, number of educational programs attended, and the proportion of income obtained from forest-related activities was weakest.

The percentage of household income from forest-related activities had a positive coefficient (as opposed to its role in predicting the probability of use of technical assistance), suggesting that the more income is generated from forest, the more likely an individual will use

financial assistance. A possible explanation is that financial assistance helps to minimize the owners' costs unlike technical assistance which, when well mastered by the owner, can be reduced or omitted. Also, financial assistance for managing the land may lead to a higher forest-related income.

The developed model correctly classified 79% of all cases in the analysis sample; the Hosmer and Lemeshow Chi-square was significant at 0.237, meaning that the predicted and the actual classifications were not significantly different from each other. Also, when applied to classify cases from the holdout sample, the model correctly classified 72.5% of all cases. These two results allowed us to be confident that the developed model can be used to accurately predict the use of financial assistance, at least across the total sample we have for our study population.

All Practices Combined

This variable was obtained by combining all practices listed and analyzed earlier (harvesting practices, wildlife management practices, woodland management practices, use of BMPs, use of conservation easements, and use of a written management plan). The analysis sample used to develop the model included 248 cases while the holdout sample, used to validate the model included 200 cases; the respective ratios were 11/1 and 9/1. The second requirement is not met because the group of non-adopters has 16 cases; however, it was very close to 20. The results of the model development are shown in Table 57.

Table 57. Results of the logit model development for all practices combined.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	39.640			
Cox & Snell R Square	.093	From base model	24.106	.000
Nagelkerke R Square	.409	From prior step	2.874	.090

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Length of ownership	-.100	.043	5.370	1	.020	.905
Technical assistance	1.652	1.042	2.511	1	.100	5.216
Amenity motivations	.805	.380	4.498	1	.034	2.238
Direct prof. information	.979	.427	5.255	1	.022	2.663
Constant	7.074	1.850	14.622	1	.000	1180.773

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	1	6	14.3	1	8	11.1	16
Group 1: adopters	1	240	99.6	1	190	99.5	432
Overall percentage			97.2			95.5	
TOTAL	2	246		2	198		448

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	1.691	8	.989

The final model involved four variables, including length of ownership, the use of technical assistance, amenity motivations, and direct professional source of information. The error term was somewhat small (just 39.64) compared to that of the previous analyses; its decrease from the base model, as well as from the step prior to the final were significant, with respective significance levels of 0.000 and 0.090. The Nagelkerke R square was also among the largest of all the analyses done, with 0.409. This means that about 41% of the variance in the probability for a NIPF owner to adopt any practice was accounted for by the four variables in the final model.

All four variables had coefficients significantly different from zero; this means that changes in any of them would have an effect on the probability of a person to be an adopter. Three of the four variables had positive coefficients; with odds ratios for adoption of any practice of 5.21, 2.23, and 2.66 respectively for technical assistance, amenity motivations, and

information obtained from direct interaction from professionals; suggesting that technical assistance was the strongest predictor, followed by direct professional information and amenity motivations. The only variable that had a negative coefficient was “length of ownership.” This negative coefficient suggested that the longer an individual owns his/her land, the less likely he/she would be an adopter of sustainable forestry practices in general. The odds ratio for adoption of any practice corresponding to the variable was 0.9. This result agrees with Kendra and Hull’s (2005) findings, who segmented NIPF owners into five groups according to their motivations for owning land (*absentee investors, professionals, preservationists, forest planners, and young families*); they found that *preservationists* was the group of owners who tended to keep their land the longest (more than twice as long as the average tenure), mostly to pass it to their heirs, without doing much on it; among the five, this group was the most suspicious and trusted forestry professionals the least. Technical assistance was the variable having the most effect on the probability of an individual to be an adopter, followed by direct professional sources of information, amenity motivations, and the length of land tenure.

The final model correctly classified 97.2% of all cases used in the analysis, with a Hosmer and Lemeshow Chi-square of 1.691, significant at 0.989; meaning that there was no difference between the predicted and the actual classification. Also, when used to classify the cases from the holdout sample, the model correctly classified 95.5% of all cases. These results demonstrated the accuracy of the model in predicting whether a person is a likely adopter or not.

The models developed here suggested that there is no standard model for predicting the likelihood of adoption of practices; factors explaining the adoption differ for each group of practices. However, of all the factors explaining the groups of practices, only technical assistance seemed to be a significant predictor across the groups of practices when it comes to the three common types of assistance: technical, financial, and educational. The following section deals with how important these sources of assistance are when taken separately.

Importance of the Technical, Financial, and Educational Assistance in Predicting Adoption of Practices

In the questionnaire, respondents were asked to rate the importance of financial, technical and educational assistance in making decisions for managing their land, using a four-point importance scale with 1 being "very unimportant" and 4 "very important".

The Cronbach's alpha value to measure the reliability for the scale is 0.753, which is slightly higher than 0.7, suggesting that the measures are reliable. Table 58 shows the results of the rating based on 971 responses.

Table 58. Ranking of the three types of assistance according to respondents' perceptions.

	Very unimportant	Somewhat unimportant	Somewhat important	Very important
Technical assistance	15	9	24	52
Financial assistance	32	18	27	23
Educational programs/ materials	22	15	36	28

Technical assistance was considered as most important form of assistance with 52% of respondents rating it as very important. Educational assistance and financial assistance were rated similarly. Blatner et al. (1991) estimated a total of 47% of NIPF in Washington State to have used at least one of the three forms of assistance (technical assistance, educational assistance and financial assistance). In their study, 79 to 90% of NIPF owners rated the usefulness of the assistance they received as good/excellent. Educational programs are provided by a number of sources depending on the purpose; owners then can choose the ones that fit their objectives. Assistance providers include Cooperative Extension, providing educational and technical assistance; state agencies, providing mostly technical and financial assistance through tax incentives and/or cost-share programs; and the private sector. An estimated 23% of NIPF received educational assistance in Washington whether it was through newsletters or publications (Blatner et al. 1991); 12 to 18% of NIPF owners received technical assistance from one-on-one technical advice from professionals; other numbers were also estimated for the use of technical assistance from previous studies, including Butler et al. (2007), with 16%, Crowther (1990) with 23% and Egan and Jones (1993), with 20%. An estimated 15% of NIPF owners also used financial assistance (Blatner et al. 1991). None of the mentioned studies directly compared the relative importance of the three forms of assistance but according to their data, we would

expect educational programs to be the highest ranked, followed by either technical assistance or financial assistance; however, our findings did not go the same way, because technical assistance was rated highest, with the two other forms of assistance rated about the same. A possible explanation of that perception is related to the notion of palpability; we mentioned earlier that hands-on approaches are most preferred by owners; likewise, educational programs through newsletters and publications could be perceived as interesting and important, but not as important as actually implementing the practices on the field with professionals to help.

We saw from all the models developed so far that technical assistance was shown to be a significant predictor of the adoption of four groups of practices (overall practices, harvesting practices, woodland management practices, and the use of a written management plan). "Educational programs" was retained as a significant predictor only once (when predicting the likelihood of an individual to use financial assistance). Likewise, financial assistance was a significant predictor only for the likelihood of adoption of BMPs. This section reports the results when using only the three sources of assistance as predictor variables in the logistic regression analysis for adoption of various sustainable forestry practices.

More cases could be used for the development of the models in this section because there were only three independent variables; thus, fewer cases were excluded from the analysis compared to the previous section. Table 59 shows the variables used for the analyses in this section.

Table 59. List of variables used in the reduced model of logistic regression.

Dependent variables	
Harvesting practices	Dummy
Wildlife management practices	Dummy
Woodland management practices	Dummy
BMP practices	Dummy
Conservation easements	Dummy
Use of a written management plan	Dummy
Overall practices	Dummy

Independent variables	
Educational programs	Continuous
Use of technical assistance	Dummy
Use of financial assistance	Dummy

Harvesting Practices

There were 342 cases used to build the model and 290 for validating it; resulting in ratios of the number of cases to the number of independent variables of 114/1 for the analysis sample and 96/1 for the holdout sample. There were 69 non-adopters and 563 adopters; which means that both requirements were met. The results of the model development are shown in Table 60.

Table 60. Results of the logit model for harvesting practices using assistance variables.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	220.395			
Cox & Snell R Square	.052	From base model	18.206	.000
Nagelkerke R Square	.103	From prior step	18.206	.000

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	1.504	.364	17.066	1	.000	4.501
Constant	1.292	.226	32.737	1	.000	3.640

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	0	38	.0	0	31	.0	69
Group 1: adopters	0	304	100.0	0	259	100.0	563
Overall percentage			88.9			89.3	
TOTAL	0	342		0	290		632

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

The model entered only technical assistance as a significant predictor, which was the same variable entered for the harvesting practices in the bigger model (with 22 initial variables). The coefficient was significantly different from zero, and positive; suggesting people using technical assistance are more likely to adopt harvesting practices. The analysis sample correctly classified 88.9% of all cases in the analysis sample and 89.3% of all cases in the holdout sample. These results did not differ much from the analysis previously conducted to predict harvesting practices.

Wildlife Management Practices

The total number of cases used for developing the model was 294, leaving 271 other cases to test the developed model. The respective ratios were 98/1 and 90/1; and with 125 non-adopters and 440 adopters, both requirements were met. The results are shown in Table 61.

Table 61. Results of the logit model for Wildlife management practices using assistance variables.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	309.120			
Cox & Snell R Square	.030	From base model	8.890	.003
Nagelkerke R Square	.045	From prior step	8.890	.003

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	.838	.281	8.867	1	.003	2.311
Constant	.721	.203	12.574	1	.000	2.056

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	0	68	.0	0	57	.0	125
Group 1: adopters	0	226	100.0	0	214	100.0	440
Overall percentage			76.9			79.0	
TOTAL	0	294		0	271		565

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

The only variable entered in the model was technical assistance, with a positive coefficient significantly different from zero. The model explained 4.5% of the variance in the likelihood of an individual to adopt wildlife management practices.

The developed model correctly classified 76.9% of the cases in the analysis sample, and 79% of the cases from the validation sample.

Woodland Management Practices

We used 513 cases to develop the model and 430 cases to validate it. The respective ratios were 171/1 and 143/1; and with 130 non-adopters and 813 adopters, both requirements were met. The results of the development of the model are shown in Table 62.

Table 62. Results of the logit model for woodland management practices using assistance variables.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	403.835			
Cox & Snell R Square	.093	From base model	50.305	.000
Nagelkerke R Square	.159	From prior step	4.593	.032

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	1.717	.285	36.214	1	.000	5.565
Educational program	.108	.054	4.021	1	.045	1.114
Constant	.763	.166	21.046	1	.000	2.144

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	0	83	.0	0	47	.0	130
Group 1: adopters	0	430	100.0	0	383	100.0	813
Overall percentage			83.8			89.1	
TOTAL	0	513		0	430		943

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	5.183	6	.521

The model entered two of the three variables; the changes in the error term were very significant at each step. Both variables had positive, significantly different from zero coefficients, but technical assistance explained the likelihood of adoption of woodland management practices more than did educational programs, their respective coefficients were 1.717 and 0.108, with odds ratios of 5.51 and 1.11. The developed model correctly classified 83.8% of the cases in the analysis sample, with a Hosmer and Lemeshow Chi-square significant

at 0.521, suggesting the predicted and the actual classifications were not different. Also, the developed model correctly classified 89.1% of the cases in the validation sample.

Use of Best Management Practices

For this analysis, 389 cases were selected for developing the model, and 327 for its validation; the respective ratios were 129/1 and 109/1; and with 192 non-adopters and 524 adopters, both requirements are met. The results of the model development are shown in Table 63.

Table 63. Results of the logit model for BMPs using assistance variables.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	393.764			
Cox & Snell R Square	.120	From base model	49.672	.000
Nagelkerke R Square	.176	From prior step	12.838	.000

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Financial assistance	1.654	.422	15.342	1	.000	5.227
Educational program	.192	.059	10.403	1	.001	1.211
Constant	.394	.151	6.847	1	.009	1.483

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	0	100	.0	0	92	.0	192
Group 1: adopters	0	289	100.0	0	235	100.0	524
Overall percentage			74.3			71.9	
TOTAL	0	389		0	327		716

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	14.972	5	.010

Financial assistance and educational programs were entered in the model; both variables had positive, significantly different from zero coefficients, with financial assistance having more effect on the likelihood of an individual to adopt BMP practices on their land. Eighteen percent

of the variance in the likelihood of an individual adopting BMPs was accounted for by the two variables in the model.

The Hosmer and Lemeshow Chi square significance level is 0.01, which means the predicted and the actual classification were significantly different from each other. This could suggest the developed model was not accurate to predict an individual's likelihood of adopting BMPs; however, the model still correctly classified 74.3% of all the analysis cases, as well as 71.9% of all cases in the validation sample.

Conservation Easements

The respective number of cases used for the analysis sample and the validation sample were 561 and 549; both ratios were 187/1 and 183/1; and with 947 non-adopters and 73 adopters, both requirements were met. Only the financial assistance variable was entered in the model. Details about the development of the model are shown in Table 64.

Table 64. Results of the logit model for conservation easements using assistance variables.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	284.588			
Cox & Snell R Square	.007	From base model	3.757	0.053
Nagelkerke R Square	.017	From prior step	3.757	0.053

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Financial assistance	.699	.348	4.025	1	.045	2.012
Constant	-2.760	.202	186.341	1	.000	.063

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	521	0	100.0	426	0	100.0	947
Group 1: adopters	40	0	.0	33	0	.0	73
Overall percentage			92.9			92.8	
TOTAL	561	0		459	0		1020

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

Financial assistance was the only variable entered in the model, it had a positive, significantly different from zero coefficient. This suggested that people who used financial assistance were more likely to adopt conservation easement practices than others who did not.

The developed model correctly classified 92.9% (hit ratio) of all cases from the analysis sample and 92.8% of all cases in the validation sample.

Use of a Written Management Plan

The analysis sample involved 540 cases while the validation sample used 454 cases; the respective ratios were 25/1 and 20/1; and with 716 non-adopters and 278 adopters, both requirements were met. The developed models entered two variables and Table 65 shows the detailed results about the development of the model.

Table 65. Results of the logit model for the use of a management plan, using assistance variables.

Overall model fit

Goodness of fit measures	Value			
		Change in -2LL	Value	Significance
-2 log likelihood	527.669			
Cox & Snell R Square	.179	From base model	106.581	.000
Nagelkerke R Square	.259	From prior step	3.646	.056

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	2.246	.262	73.345	1	.000	9.454
Educational program	.071	.037	3.684	1	.055	1.074
Constant	-2.600	.246	111.794	1	.000	.074

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	374	18	95.4	310	14	95.7	716
Group 1: adopters	130	18	12.2	112	18	13.8	278
Overall percentage			72.6			72.2	
TOTAL	504	36		422	32		994

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	5.904	6	.434

The decrease in the error term from the base model to the final model was extremely significant (Chi-square value of 106.58 significant at 0.000). Of the variance in the likelihood of an individual to adopt a written management plan, 25.9% was accounted for by technical assistance and educational programs. Technical assistance and educational program were entered in the model; both with positive, significantly different from zero coefficients. Technical assistance (with a coefficient of 2.246) had a greater effect than educational programs (with a coefficient of 0.071) on the probability of an individual to adopt a written management plan.

The model correctly classified 72.6% of all cases from the analysis sample, with a Hosmer and Lemeshow Chi-square value of 5.904, significant at 0.434; which means that the predicted classification was not significantly different from the actual one. Also, the model correctly classified 72.2 of all cases from the validation sample.

All Practices Combined

The "overall practices" variable was the combination of all independent variables in the analysis in this section (i.e., harvesting practices, wildlife management practices, and woodland management practices, use of BMPs, use of conservation easements, and use of a written management plan). The analysis sample involved 571 cases while the validation sample used 468 cases; the respective ratios were 26/1 and 21/1; and with 82 non-adopters and 957 adopters, both requirements were met. Below are the results of the model development. Table 66 provides the results of the model development.

Table 66. Results of the logit model for all practices combined, using assistance variables.

Overall model fit

Goodness of fit measures	Value	Change in -2LL	Value	Significance
-2 log likelihood	256.263			
Cox & Snell R Square	.098	From base model	58.759	.000
Nagelkerke R Square	.231	From prior step	22.570	.000

Variables in the equation

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
Technical assistance	2.295	.485	22.399	1	.000	9.922
Financial assistance	37.540	$3\ 10^{7}$	.000	1	1.000	$2\ 10^{16}$
Constant	1.499	.175	73.415	1	.000	4.475

Classification matrix

	Predicted group membership						
	Analysis sample (a)			Holdout sample (b)			
Observed group membership	Group 0	Group 1	% correct	Group 0	Group 1	% correct	TOTAL
Group 0: non-adopters	0	45	.0	0	37	.0	82
Group 1: adopters	0	526	100.0	0	431	100.0	957
Overall percentage			92.1			92.1	
TOTAL	0	571		0	468		1039

a Selected cases Approximately 55 % of cases (SAMPLE) EQ 1

b Some of the unselected cases are not classified due to either missing values in the independent variables or categorical variables with values out of the range of the selected cases.

	Chi square	df	Significance
Hosmer and Lemeshow	.000	1	1.000

The decrease in the error term was very significant both from the base model to the final model and from the first to the final model (both Chi square values significant at 0.00). Of the variance in the likelihood of a person to adopt any of the practices, 23.1% was accounted for by technical assistance and financial assistance combined. Both variables had positive coefficients, technical assistance had a significant coefficient but the coefficient for financial assistance was not significantly different from zero (the Wald statistic significance is 1.000); which suggested that whether an individual used financial assistance or not; it would not have changed anything when it comes to the likelihood of an individual to adopt any of the practices.

The Hosmer and Lemeshow Chi-square significance level of 1.000; which suggested the model was not accurate to predict the likelihood of people to adopt practices; however, the

developed model correctly classified 92.1% of all cases from both the analysis sample and the validation sample.

Of the three types of assistance considered in this section, the use of technical assistance was the most frequently entered predictor of the adoption of practices, it appeared in five of the seven models developed; educational programs and financial assistance both appeared three times. If only considering the three assistance variables, adoption of two groups of practices (harvesting practices and wildlife management practices) were explained by technical assistance only; adoption of conservation easements was explained only by the use of financial assistance; adoption of woodland management and written management plan was explained by the use of technical assistance and educational programs combined, with a greater explanation by technical assistance. The adoption of BMPs was explained by the combination of financial assistance and educational programs with financial assistance having a greater effect; and interestingly, the adoption of any practice was explained by the use of technical assistance and financial assistance combined; again, with technical assistance having a greater effect.

In light of the analyses done so far, educational programs did not figure as one of the major predictor variables; however, it was significant for key practices such as woodland management practices, which includes many practices for managing forest land, and in the use of Best Management Practices, on which the sustainability of soil and water quality depends.

In general, we can say that for the same practices, the models developed using all variables have a much smaller error term (-2 log likelihood), are more accurate in classifying the cases (have higher hit ratios) for both the analysis and the holdout samples, and have higher Nagelkerke R square compared to the models developed using only the three types of assistance variables. Though the models developed from the three type of assistance explained less variance of the likelihood of an individual to be an adopter, they explained a substantial amount of variance in the likelihood of adoption of practices as shown in Table 67.

Table 67. Proportion of variance of the dependent variable explained by the two groups of models.

Practices	Full model R square	Assistance-model R square	Assistance-model R square (%)
Harvesting	0.137	0.103	75.2
Wildlife	0.195	0.045	23.1
Woodland	0.407	0.159	39.1
BMPs	0.202	0.176	87.1
Conservation easement	0.075	0.017	22.7
Written management plan	0.261	0.259	99.2
All practices combined	0.409	0.231	56.5

Assistance-model R square (%) represents the proportion of the R square for the assistance model as to that of the full model.

In fact, by using just the assistance variables, the parts of variance of the likelihood of adoption of a given practice explained range from 1.7% for adoption of conservation easements to 25.9% for adoption of written management plan. On the other hand, for the full model (using all variables to develop the models), the explained variance in likelihood of adoption range from 7.5% to 40.9% for all practices combined. Considering those numbers, we can see that the proportion of explanation of variance in the likelihood of adoption by the assistance models range from 22.67% (for conservation easements) to 99.23% (for written management plan) of the total variance explained by the full models; as shown in Table 67.

Predicted probabilities of adoption for each group of practices

So far, all the discussions about the developed models were not really tangible; this section discusses more about what the developed models actually mean in terms of probability of adoption, and how they provide useful information for future approaches/ channels to bring NIPF owners to adopt a given practice.

The determined coefficients determined during the models development allowed us to have the following logistic regression equations:

Harvesting practices

$z = 1.153 + 1.765$ (technical assistance)

Wildlife management practices

$z = 1.096 + 1.245$ (Management plan) $+ 0.733$ (Time/labor constraints)

Woodland management

z=2.87+2.236(technical assistance)-0.055(ownership length)+0.562(amenity motivations)+0.5(economic motivations)+0.559(recreation motivations)

Best management practices

z= 0.915 + 2.457 (Financial assistance) + 0.534 (Human-related constraints)

Conservation easements

z= -2.514 - 0.443 (self-learning information) – 0.509 (scale-related constraints)

All practices combined

z=7.074+1.652(technical assistance)-0.1(ownership length)+0.805(amenity motivations)+0.979 (direct professional information)

Use of a written management plan

z= -2.239+1.604(technical assistance)+0.387(recreation motivations)+0.708 (direct professional information)

Use of technical assistance

z= -0.83-0.019(income from forest)+0.255(household income)+0.538 (economic motivations)+1.728 (management plan)

Use of financial assistance

z=-3.029+0.205(educational program)+ 0.051(forest income)+0.303 (household income)+0.492 (direct professional information)

These "z" equations tell us which variables were significant for predicting a given practice, but they do not directly provide the probability of adoption that we are interested in. The probability of adoption was obtained by using the formula:

$$p_{(adoption)} = \frac{1}{(1+e^{-z})}$$

By using this formula and by using the predictor values mentioned in Appendix P, we obtained the probabilities of adoption for each group of practices. Owners who used technical assistance are more likely to be adopters of harvesting practices (Table 68). Using technical assistance added 18% to the probability of adoption of at least one of the mentioned harvesting practices.

Table 68. Probabilities of adoption of harvesting practices.

	Technical assistance	
	No	Yes
Probability of adoption	76	94.9

Likewise, we computed the probabilities of adoption of wildlife management practices; Table 69 shows the results. Owners who did not use a written management plan, and perceived time/labor as being low constraints to active forest management are the least likely to adopt wildlife

management practices. On the other end of the scale, owners who used a written management plan, and perceived time/labor as highly limiting to active forest management are the most likely to be adopters of wildlife management practices.

Table 69. Probabilities of adoption of wildlife management practices

Written management plan	Time/labor constraints	Probability (%)
No	Low	45.0
	Medium	74.3
	High	91.0
yes	Low	74.0
	Medium	90.9
	High	97.2

Using a written management plan increased the probability of adoption of wildlife management, with additional probabilities ranging from 6% to 29% when keeping time and labor constraints at the same levels. On the other hand, while controlling for written management plan, an increase of one level (from low to medium, or from medium to high) in the time/labor constraints also brought additional probabilities of adoption of wildlife management practices ranging from 6% to 29%. Both predictors are equally important but actions on a written management plan would be more effective in getting NIPF owners to adopt wildlife management practices; it does not make much sense to increase the perception of time/labor constraints as an approach to get owners to adopt wildlife management practices.

Owners who did not use financial assistance and perceived human-related constraints as being not much of a barrier to active forest management are the least likely to adopt BMPs while owners who used technical assistance and perceived human-related constraints as a serious barrier to active forest management are the ones most likely to adopt BMPs (Table 70).

Table 70. Probabilities of adoption of Best Management Practices.

Financial assistance	Human-related constraints	Probability (%)
No	Low	49.5
	Medium	71.4
	High	88.1
Yes	Low	92.0
	Medium	96.7
	High	98.9

The use of financial assistance while controlling for human-related constraints brought additional probabilities for adoption of BMPs ranging from 10% to 43%; on the other hand, an increase of one level in human-related constraints while controlling for financial assistance translated in an additional probability of adoption of BMPs ranging from 2% to 22%. These results indicate that financial incentives are likely more effective to bring owners to adopt BMPs.

Owners who considered self-learning information highly useful for managing land, and perceived scale-related constraints as being very limiting to active forest management, are least likely to adopt conservation easements (with only 1.8% probability to adopt), while owners who considered self-learning information least useful for managing land, and perceived scale-related constraints as not being limiting to active forest management, are most likely to adopt conservation easements (Table 71).

Table 71. Probabilities of adoption of conservation easement programs

Self-learning information	Scale-related constraints	Probability (%)
Low	Low	26.9
	Medium	13.9
	High	6.7
Medium	Low	14.8
	Medium	7.1
	High	3.3
High	Low	8.5
	Medium	3.9
	High	1.8

An increase in the perception of importance of self-learning sources of information from the lowest to the highest level while controlling for scale-related constraints decreased the probability of adoption of any conservation easement program by 5% to 18%. When controlling for the self-learning variable, the increase in the level of the importance of scale-related constraints from the lowest to the highest translated into a decrease ranging from 7% to 20%. These results suggest two options for getting owners to adopt conservation easement programs: First, reducing the perception that self-learning sources of information are very important, by providing them with alternatives, such as informing them about how useful, important, and adequate to their needs information from professionals are; and second, taking actions on reducing the scale-related constraints. Since it is not possible to donate more land to owners to increase their scale, actions would be oriented toward providing them with information about the

larger scale, i.e., the benefits of having contiguous small parcels of land put under easement, rather than just focusing on their small personal land.

The top end of the continuum of adoption of any practice in Table 72 did not provide much information given the large number of practices that owners could implement because an owner who implemented one practice out of a total of 51 was considered as adopter; which tended to increase the probability of adoption significantly and got it close to 1. However, the results showed that owners who did not use technical assistance, owned their land for more than 30 years, had less amenity motivations, and perceived information obtained from direct interaction with professionals not useful for managing land, were the least likely to adopt any kind of practice on their land, and that despite the large array of practices available, their probability to adopt any single individual practice within any of the eight groups of practices was 77%.

Table 72. Probabilities of adoption of any one practice.

Technical assistance	Length of ownership	Amenity motivations	Direct professional information	Probability (%)
No	Short	Low	Low	97.7
			Medium	99.6
			High	99.9
		Medium	Low	99.4
			Medium	99.9
			High	100.0
		High	Low	99.8
			Medium	100.0
			High	100.0
	Medium	Low	Low	90.3
			Medium	98.1
			High	99.5
		Medium	Low	97.5
			Medium	99.5
			High	99.9
		High	Low	98.9
			Medium	99.8
			High	99.9
	Long	Low	Low	77.3
			Medium	95.0
			High	98.6
		Medium	Low	93.5
			Medium	98.8
			High	99.7
		High	Low	97.0
			Medium	99.5
			High	99.9
Yes	Short	Low	Low	99.5
			Medium	99.9
			High	100.0
		Medium	Low	99.9
			Medium	100.0
			High	100.0
		High	Low	100.0
			Medium	100.0
			High	100.0
	Medium	Low	Low	98.0
			Medium	99.6
			High	99.9
		Medium	Low	99.5
			Medium	99.9
			High	100.0
		High	Low	99.8
			Medium	100.0
			High	100.0
	Long	Low	Low	94.7
			Medium	99.0
			High	99.7
		Medium	Low	98.7
			Medium	99.8
			High	99.9
		High	Low	99.4
			Medium	99.9
			High	100.0

Table 73 suggests that owners who did not use technical assistance, had low motivations for wilderness/gaming, and considered direct interaction with professionals not as an important source of information are the least likely to use a written management plan (only 1.9% of probability to use a written management plan). On the other hand, owners who were using technical assistance, had high wilderness/gaming motivations, considered direct interaction with professionals as an important source of information are the most likely to use a written management plan on their land (with 74% of probability to use a plan).

Table 73. Probability of using a written management plan

Technical assistance	Recreation motivations	Direct professional information	Probability (%)
No	Low	Low	1.9
		Medium	6.2
		High	14.5
	Medium	Low	3.3
		Medium	10.6
		High	23.2
	High	Low	6.0
		Medium	18.3
		High	36.4
Yes	Low	Low	8.6
		Medium	24.7
		High	45.7
	Medium	Low	14.4
		Medium	37.0
		High	60.1
	High	Low	24.2
		Medium	52.6
		High	74.0

Table 74 implies that owners who did not use technical assistance, owned their land for more than 30 years, had low amenity, economic and wilderness/gaming motivations are the least likely to adopt woodland management practices (with only 20% of probability of adoption). They are followed by owners who did not use technical assistance, owned their land for more between 10 and 20 years, had low amenity, economic and wilderness/gaming motivations, with 31% of probability of adoption. The owners most likely to adopt woodland management practices were those who used technical assistance, owned their land for less than 10 years, and had high amenity, economic, and wilderness/gaming motivations altogether (99.9% of probability of adoption of at least one woodland management practice).

Table 74. Probabilities of adoption of woodland management practices.

Technical assistance	Length of ownership	Amenity motivations	Economic motivations	Recreation motivations	Probability (%)
No	Short	Low	Low	Low	50.8
				Medium	70.5
				High	85.7
			Medium	Low	70.1
				Medium	84.4
				High	93.2
			High	Low	82.8
				Medium	91.8
				High	96.6
		Medium	Low	Low	73.7
				Medium	86.6
				High	94.2
			Medium	Low	86.4
				Medium	93.6
				High	97.4
			High	Low	92.9
				Medium	96.8
				High	98.7
		High	Low	Low	83.3
				Medium	92.0
				High	96.7
			Medium	Low	91.9
				Medium	96.3
				High	98.5
			High	Low	95.9
				Medium	98.2
				High	99.3
	Medium	Low	Low	Low	31.1
				Medium	51.1
				High	72.5
			Medium	Low	50.7
				Medium	70.4
				High	85.7
			High	Low	67.8
				Medium	83.0
				High	92.5
		Medium	Low	Low	55.1
				Medium	74.0
				High	87.7
			Medium	Low	73.6
				Medium	86.6
				High	94.2
			High	Low	85.2
				Medium	93.0
				High	97.1
		High	Low	Low	68.7
				Medium	83.5
				High	92.7
			Medium	Low	83.3
				Medium	92.0
				High	96.7
			High	Low	91.1
				Medium	95.9
				High	98.3
	Long	Low	Low	Low	20.7
				Medium	37.6
				High	60.3
			Medium	Low	37.2
				Medium	57.8
				High	77.5
			High	Low	54.9
				Medium	73.8
				High	87.6
		Medium	Low	Low	41.5
				Medium	62.1
				High	80.5
			Medium	Low	61.7
				Medium	78.8
				High	90.4
			High	Low	76.8
				Medium	88.4
				High	95.1
		High	Low	Low	55.9
				Medium	74.5
				High	88.0
			Medium	Low	74.2
				Medium	86.9
				High	94.4
			High	Low	85.5
				Medium	93.2
				High	97.2

Technical assistance	Length of ownership	Amenity motivations	Economic motivations	Recreation motivations	Probability (%)
Yes	Short	Low	Low	Low	90.6
				Medium	95.7
				High	98.3
			Medium	Low	95.6
				Medium	98.1
				High	99.2
			High	Low	97.8
				Medium	99.0
				High	99.6
		Medium	Low	Low	96.3
				Medium	98.4
				High	99.3
			Medium	Low	98.3
				Medium	99.3
				High	99.7
			High	Low	99.2
				Medium	99.6
				High	99.9
		High	Low	Low	97.9
				Medium	99.1
				High	99.6
			Medium	Low	99.1
				Medium	99.6
				High	99.8
			High	Low	99.5
				Medium	99.8
				High	99.9
	Medium	Low	Low	Low	80.9
				Medium	90.7
				High	96.1
			Medium	Low	90.6
				Medium	95.7
				High	98.2
			High	Low	95.2
				Medium	97.9
				High	99.1
		Medium	Low	Low	92.0
				Medium	96.4
				High	98.5
			Medium	Low	96.3
				Medium	98.4
				High	99.3
			High	Low	98.2
				Medium	99.2
				High	99.7
		High	Low	Low	95.4
				Medium	97.9
				High	99.2
			Medium	Low	97.9
				Medium	99.1
				High	99.6
			High	Low	99.0
				Medium	99.6
				High	99.8
	Long	Low	Low	Low	70.9
				Medium	84.9
				High	93.4
			Medium	Low	84.7
				Medium	92.8
				High	97.0
			High	Low	91.9
				Medium	96.3
				High	98.5
		Medium	Low	Low	86.9
				Medium	93.9
				High	97.5
			Medium	Low	93.8
				Medium	97.2
				High	98.9
			High	Low	96.9
				Medium	98.6
				High	99.4
		High	Low	Low	92.2
				Medium	96.5
				High	98.6
			Medium	Low	96.4
				Medium	98.4
				High	99.4
			High	Low	98.2
				Medium	99.2
				High	99.7

In general, owners who did not use technical assistance, owned their land for more than 30 years, and had lower motivations tended to be less likely adopters of woodland management practices than owners who used technical assistance, owned their land for less than 30 years, and had higher motivations (the probability of adoption were extremely high when these three conditions were satisfied). We may also pinpoint that between owners who used technical assistance, neither the length of tenure, nor the three types of motivations made as much difference in terms of probability of adoption of woodland management practices, with the biggest gap of 29% (probabilities of adoption ranging from 71% to 99%) as it did between owners who did not use technical assistance, with the biggest difference of 78% (probabilities of adoption ranging from 21% to 99%).

As shown in Table 75, owners who did not use a written management plan, did not earn any income from their forest, had low household income (less than $25,000 annual), and had low economic motivations were the least likely to use technical assistance (probability of adoption of 19%). In contrast, owners who used a written management plan, had no income generated from the forest, had high household income ($100,000 annual or more), and had high economic motivations were the most likely to use technical assistance (with probability of adoption of 94.4%). Income earned from the forest did not really matter for the likely adopters, with the probabilities of adoption ranging from 93.9% to 94.4%.

Table 75. Probabilities of using technical assistance.

Written management plan	Income from forest (%)	Household income	Economic motivations	Probability (%)
No	None	Low	Low	19.0
			Medium	36.1
			High	55.1
		Medium	Low	25.6
			Medium	45.3
			High	64.3
		High	Low	36.4
			Medium	58.0
			High	75.0
	Low	Low	Low	18.4
			Medium	35.3
			High	54.2
		Medium	Low	24.8
			Medium	44.4
			High	63.4
		High	Low	35.5
			Medium	57.1
			High	74.3
	High	Low	Low	17.6
			Medium	34.0
			High	52.7
		Medium	Low	23.8
			Medium	43.0
			High	62.1
		High	Low	34.2
			Medium	55.7
			High	73.2
Yes	None	Low	Low	56.9
			Medium	76.1
			High	87.4
		Medium	Low	65.9
			Medium	82.4
			High	91.0
		High	Low	76.3
			Medium	88.6
			High	94.4
	Low	Low	Low	55.9
			Medium	75.4
			High	86.9
		Medium	Low	65.0
			Medium	81.8
			High	90.7
		High	Low	75.6
			Medium	88.2
			High	94.2
	High	Low	Low	54.5
			Medium	74.3
			High	86.3
		Medium	Low	63.7
			Medium	80.9
			High	90.2
		High	Low	74.5
			Medium	87.6
			High	93.9

Owners who earned no income from their forest, had low household income (less than $25,000 annual), perceived information from direct interaction with professionals not useful for managing forest land, and who never attended any educational program in the past 11 years were the least likely to use financial assistance for activities related to forest management on their land their probability of using financial assistance was only 2.9% (Table 76). In contrast, owners who were the most likely to use financial assistance were those who earned substantial amount of income from their forest (more than 5% of their total household income), earned more than $100,000 per year as household income, considered information received from direct interaction with professionals highly important, and attended educational programs frequently (more than ten times in the past 11 years); their probability of using technical assistance was 79.8%. We may also note that the frequency of attendance at educational programs brought an additional probability of using financial assistance ranging from 20% to 47% when controlling for all other predictors; this suggests the high importance of educational programs in bringing owners to use financial assistance.

Table 76. Probabilities of using financial assistance

Income from forest (%)	Household income	Direct professional information	Educational programs	Probability (%)
None	Low	Low	Never	2.9
			Rarely	5.2
			Somewhat frequently	13.3
			Frequently	18.8
		Medium	Never	6.6
			Rarely	11.6
			Somewhat frequently	26.8
			Frequently	35.5
		High	Never	12.0
			Rarely	20.1
			Somewhat frequently	41.3
			Frequently	51.4
	Medium	Low	Never	4.5
			Rarely	8.0
			Somewhat frequently	19.5
			Frequently	26.7
		Medium	Never	10.0
			Rarely	17.1
			Somewhat frequently	36.5
			Frequently	46.4
		High	Never	17.7
			Rarely	28.4
			Somewhat frequently	52.5
			Frequently	62.5

Income from forest (%)	Household income	Direct professional information	Educational programs	Probability (%)
None	High	Low	Never	7.9
			Rarely	13.7
			Somewhat frequently	30.7
			Frequently	40.1
		Medium	Never	17.0
			Rarely	27.5
			Somewhat frequently	51.3
			Frequently	61.4
		High	Never	28.2
			Rarely	42.1
			Somewhat frequently	67.0
			Frequently	75.4
Low	Low	Low	Never	3.2
			Rarely	5.8
			Somewhat frequently	14.5
			Frequently	20.4
		Medium	Never	7.3
			Rarely	12.7
			Somewhat frequently	28.8
			Frequently	37.9
		High	Never	13.1
			Rarely	21.8
			Somewhat frequently	43.8
			Frequently	54.0
	Medium	Low	Never	4.9
			Rarely	8.8
			Somewhat frequently	21.1
			Frequently	28.8
		Medium	Never	11.0
			Rarely	18.6
			Somewhat frequently	38.9
			Frequently	49.0
		High	Never	19.2
			Rarely	30.5
			Somewhat frequently	55.1
			Frequently	64.9
	High	Low	Never	8.7
			Rarely	15.0
			Somewhat frequently	32.9
			Frequently	42.5
		Medium	Never	18.5
			Rarely	29.5
			Somewhat frequently	53.9
			Frequently	63.8
		High	Never	30.4
			Rarely	44.6
			Somewhat frequently	69.2
			Frequently	77.2

Income from forest (%)	Household income	Direct professional information	Educational programs	Probability (%)
High	Low	Low	Never	3.7
			Rarely	6.6
			Somewhat frequently	16.5
			Frequently	23.0
		Medium	Never	8.4
			Rarely	14.5
			Somewhat frequently	32.0
			Frequently	41.5
		High	Never	15.0
			Rarely	24.5
			Somewhat frequently	47.6
			Frequently	57.7
	Medium	Low	Never	5.7
			Rarely	10.1
			Somewhat frequently	23.8
			Frequently	32.0
		Medium	Never	12.6
			Rarely	21.0
			Somewhat frequently	42.6
			Frequently	52.8
		High	Never	21.7
			Rarely	33.9
			Somewhat frequently	58.8
			Frequently	68.3
	High	Low	Never	10.0
			Rarely	17.0
			Somewhat frequently	36.4
			Frequently	46.3
		Medium	Never	20.9
			Rarely	32.8
			Somewhat frequently	57.6
			Frequently	67.2
		High	Never	33.7
			Rarely	48.4
			Somewhat frequently	72.4
			Frequently	79.8

Conclusion

Although the study population used in this analysis has similarities with the general population of NIPF owners in several aspects (the majority over 60 years of age, had harvested at some point in the past 10 years, did not commonly attend educational programs but used technical assistance, relatively little use of written management plans and financial assistance, place high emphasis on amenity values of the forest and less on other ones, including economic values). It is also somewhat different from the general NIPF owner population in other important aspects. Our study population earned more income, had more land than the general population of NIPF owners; had more resident owners than the general population of NIPF owners, the majority considered themselves as being innovators and early adopters (which suggests that this study population is more open to innovations than the general population of NIPF owners), thus expected to be likely adopters compared to the general population of NIPF owners. For those reasons, the results obtained in this research provided us valuable information about understanding what brings NIPF owners to adopt a given practice, however, the differences between this study population and the population should be taken into account. In other words, we should be cautious about the limits of replicability and generalizability of the results of this study.

The models developed in this paper accounted for an average of 24% of the variance in the likelihood of a person to adopt a given SFM practice, with values ranging from 7.5% to 40.9% for the full models. The proposed theoretical model developed for this research (Figure 5) helped understand and explain the adoption of sustainable forestry practices by NIPF owners. The prediction models developed here could have been improved if variables such as labor (that had to be eliminated from the analysis because too few people provided data) could have been used in the analysis. The developed full models were generally satisfactory in predicting the likelihood of adoption of practices because the correct classification of cases ranged from 69% to 97%. Those numbers suggest that the developed models are relatively robust, at least for our study population.

Another finding of this study was the fact that attending educational programs did not necessarily translate into adoption of a given practice. Various factors, including technical assistance, direct interaction with professionals, amenity motivations or financial assistance

proved to be more important in explaining a person's likelihood of adoption of a given practice. One possible reason that might explain this fact is that we did not use enough indicators for measuring educational programs in a qualitative way. Indeed, we used the frequency of attendance of educational programs as the only indicator for educational programs. A better indicator could be to include qualitative elements in the questionnaire (questions asking the usefulness/practicality of the educational programs respondents attended). Another reason that could explain educational program not being significant of adoption of most practices is that educational programs might have a different role related to NIPF behavior, aside from the role of trigger for behavioral implementation, and adoption we thought. Given the demographics of our study population (at least our sample) perhaps, educational programs did not trigger any SFM behavior but instead, NIPF owners needed them for better results on what they were already implementing on their land. Despite these limitations, educational programs was among the significant predictors of several key practices such as woodland management practices, BMPs, or the use of a written management plan.

To conclude, we can say that this study has implications both theoretically and practically for understanding NIPF. Theoretically speaking, most of the literature about NIPF, including the most recent ones relied on either demographic or motivation variables to understand NIPF decision and/or behavior (Kluender and walkingstick, 2000; Finley et al., 2006; Kendra and Hull, 2006; Salmon et al., 2006; Butler et al., 2007; Majumdar et al., 2008, etc.). Compared to these studies, the theoretical model we proposed took into account other variables, at two different levels: at the individual level and at the social level, it also included the notion of perceived control over a given behavior that might either motivate or deter decisions going toward such a behavior depending on how much control the individual has for ensuring the wanted outcome. At the individual level, the proposed theoretical model included the individual's cognitive processing motivation and ability (which very much depends on the situation at the moment); the individual's own values and objectives. Second, at the social level: although an individual has his/her own values and objectives, he/she has to act according to his society's norms, our proposed theoretical model included that aspect to emphasize that social pressure is also very important in terms of explaining an individual's behavior, thus, all efforts trying to understand an individual's behavior should not exclude such an important aspect. Furthermore, the theoretical model developed from this study also took into account the notion of control over a given

behavior, which is a very important aspect to take into account because no matter how well an individual understands the benefits of a given innovation (or message through any sort of communication channel, including educational program). Indeed, no matter how interested and motivated this individual is to undertake it, there would be a small chance that his behavior would remain stable if too many factors are beyond his/her control; which, as we all know, is the ultimate objective for Extension and outreach efforts related to SFM practices. In the last decade or so, only Bieling (2004) in her study about NIPF adoption of close-to-nature management practices in Germany, used a similar approach as we did in our study, by using the theory of planned behavior for understanding NIPF behavior. However, her theoretical model did not include the cognitive processing aspect of the individual (i.e., the importance of the situation) which plays a major role in the individual's decision to undertake a given behavior in a stable way. In brief, our theoretical model brought new insight to better understand NIPF owners' behavior toward SFM with its four dimensions: cognitive, individual values, social values and norms, and perceived control over the behavior.

Along with its theoretical implications, the present study also has practical implications: indeed, the logistic regression models allowed us to determine which factors were significant in explaining the adoption of which practices. Knowing this information, combined with the NIPF owners' objectives would be of great help for Extension and outreach for designing their assistance programs, for identifying what type of NIPF owners are likely to adopt what type of practices. Also, it would help design the appropriate programs for assisting owners identified as less or least likely to adopt a given practice. For example, we found from our model that the significant predictors for adoption of BMPs were technical assistance and human-related constraints (timber theft, trespassing, etc). An assistance program that targets NIPF owners to adopt BMPs would be more efficient if it focuses on those two aspects, especially on technical assistance; not financial assistance, or other efforts. Another example is about woodland management practices; five predictors were significant in explaining adoption of woodland management practices: technical assistance, length of tenure, amenity motivations, recreation motivations, and economic motivations. For a program to be successful in getting NIPF owners to adopt woodland management practices, it has to emphasize technical assistance, focus on increasing people's awareness about the goods and services they can get from their forest land, including amenity values, economic benefits and recreational benefits; focusing on financial

incentives, would not of much help. To sum up, this study has practical implications in that knowing which factors are significant in explaining the adoption of a given practice allows Extension and outreach to allocate more efficiently their resources (time, money, and personnel) for better outcomes.

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ARTICLE 2: EDUCATION AND ADOPTION OF SUSTAINABLE FORESTRY PRACTICES BY PRIVATE FOREST OWNERS IN VIRGINIA

(Abstract)

It had always been thought that one of the most important reasons explaining why non-industrial private forest (NIPF) owners did not actively manage their forest land was their limited knowledge about the alternatives they have for managing their land. As a consequence, educational programs, including the Virginia Forest Landowner Education Program (provided by the Virginia Tech Department of Forestry) were promoted widely to raise NIPF owners' awareness and knowledge in these aspects and bring them to engage into active forest management. We stratified our sample into three groups of educational programs: one group consisted of owners who attended the VFLEP program, a second group of owners who attended educational programs other than the VFLEP, and the last group consisted of owners who never attended educational programs. The main goal was first to find out whether there were any demographics difference between owners who attended educational programs and those who did not, and second, whether there was any difference in terms of adoption of eight different practices (harvesting practices, wildlife management, woodland management, use of BMPs, use of written management plan, use of technical assistance, use of financial assistance, and use of conservation easement programs) between the three groups. Overall, it was determined that there were some demographics differences between owners who attended educational programs and those who did not. The study also determined that educational programs corresponded to a higher adoption of all practices, except for wildlife management practices.

Key words: VFLEP, educational programs, adoption, sustainable forestry practices, demographics.

Background

Of the 749 million acres of forest land in the whole United States, 360 million acres (48%) are under non-industrial private forest (NIPF) ownership (Salmon et al. 2006). Virginia is a heavily forested state, with about 16 million acres of forestland. Approximately 77% of the state forest base belongs to NIPF owners according to Shaffer and Meade (1997). These numbers imply that the future of Virginia's forest cannot be ensured without strong emphasis on sustainable management of NIPF lands. Ensuring the sustainable management of these forest lands includes the use of different means, one of which is providing educational programs to NIPF owners. In 1996, the Virginia Forest Landowner Education Program (VFLEP) was created from a partnership involving the Sustainable Forestry Initiative (SFI), the Virginia Department of Forestry (VDOF), the Virginia Forestry Association (VFA), and Virginia Tech's College of Natural Resources and Cooperative Extension Service (Johnson et al. 2004). The purpose of VFLEP was partly to bring non-industrial private forest (NIPF) owners to:

- Obtain professional advice and technical assistance,
- Develop and implement a written management plan,
- Obtain financial assistance through multiple cost-share opportunities,
- Adopt SFM practices.

From October 1997 through February 2004, a little less than 2,000 people had attended at one or more of the three VFLEP shortcourses offered: Woodland Options, Wildlife Options, and Timber Harvesting and Marketing.

This study was intended to determine the effectiveness of the VFLEP courses in moving the forest owner participants toward adoption of SFM practices. Since time frame for adoption of innovations varies considerably, ranging from several months to 15 years (Rogers, 2003), and since we conducted our research nine years after the program was first offered; we were assessing the impact of the program in the short and medium term.

Methods

Objectives and Hypotheses

We had three main groups within our study population: one group consisted of forest owners who attended at least one of the VFLEP shortcourses; another group consisted of owners who have not attended any of the three courses offered under the VFLEP program but attended at least one other educational program (there were various educational programs that were offered to NIPF owners other than the VFLEP program); and the last group consisted of owners who attended neither the VFLEP courses, nor any other educational program. The three groups had a common denominator in that all of them had been exposed to a common level of awareness concerning SFM and the possibility for them to attend educational programs through the Virginia Forest Landowner Update newsletter.

Testable hypotheses of this paper include the following:

- Whether there was a difference between the three groups in demographics, characteristics (land size, absenteeism), channel of information used, preferred information providers, motivations behind the ownership of land, constraints to active management of the land, and self-rating attitude toward adoption between the three groups.
- Whether there was a significant difference in adoption of active forest management practices between respondents from these three groups. In other words, whether the VFLEP program had the intended results or not compared to other references.
- Whether there was a difference in adoption of active forest management practices based on which VFLEP course(s) the owners took.

Our first hypothesis was that owners who attended courses in the VFLEP program would have a higher likelihood of adoption of practices compared to owners who did not attend any educational program; and at least the same likelihood of adoption as owners who went through other types of educational programs. Our second hypothesis was that the more VFLEP courses owners took, the more likely they were adopters of a larger array of practices, given that each course was intended for specific groups of practices. Figure 11 summarizes the overall methodology used for this study.

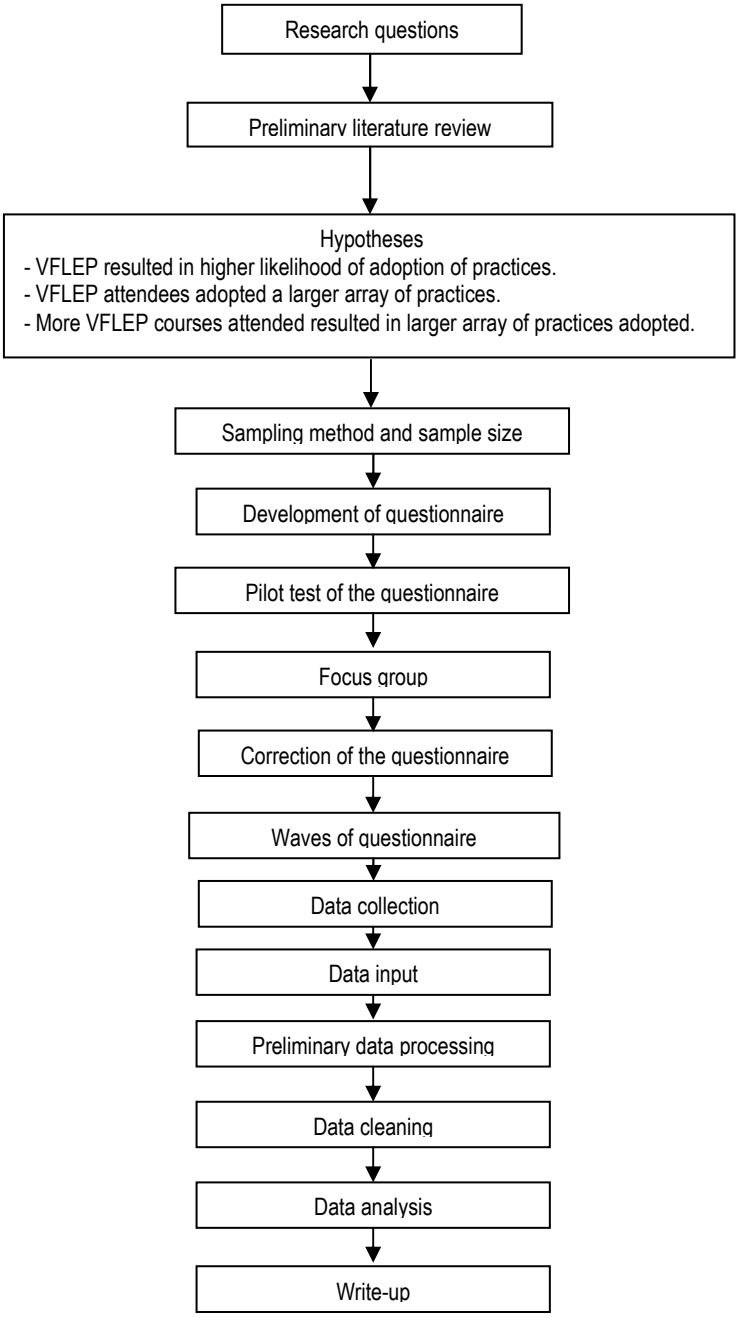

Figure 7. Overall methodology used during the research.

Sampling

The study population for this research included NIPF owners who, at some point since 1997, manifested some interest to acquire information about active forest management. The common denominator for individuals in the study population is that they all were exposed to at least one possibility of getting assistance if interested in active forest management, through a newsletter that informed them about available educational programs they can attend, as well as technical assistance and financial assistance they can ask for. We used the database with the list of Virginia non-industrial private forest owners who were exposed to the awareness about the possibility of attending the available educational programs to extract the sampling frame for this study.

Inclusion Criteria

All NIPF owners who own (or owned at some point in the past 11 years) two acres or more of forest land in Virginia.

Exclusion Criteria

- All individuals in the database who were not actual private forest landowners or who owned land elsewhere than in the state of Virginia.
- All forest owners on the list owning less than two acres of forest land.

After applying those criteria, we came up with a much more reduced list of 5,793 people in total; this shorter list constituted our sampling frame.

Sampling Design

Given the number of people in our sampling frame, we could not proceed with a census; instead, we opted for a proportionate stratified random sampling method after fixing the total sample size according to the resources available. That total sample size included 3,435 individuals, which is about 60% of the study population. Though we were considering three groups of NIPF in this study, prior to the data collection, we could only stratify our sample for two groups (the group of owners who attended the VFLEP and that of owners who did not) at the time of the survey mailing. By keeping roughly the same proportions of people in the two groups, the final sample included 1,038 owners in the VFLEP group and 2,397 in the non-VFLEP group. It was only after the data entry that we could get the third group (NIPF owners who attended at least once other educational programs than the VFLEP).

Types of Responses

Each respondent contacted either responded (response), did not (no response), or could not be reached (undeliverable questionnaire).

Responses included the following:

- Fully, partially completed questionnaires; blank questionnaires mailed back to us (not including the undeliverables),
- Respondents who contacted us by phone, by e-mail or by written statement to let us know about why they decided not to participate in the survey.

There were two types of responses: usable responses and non-usable responses.

Usable responses included:

- Fully or partially completed questionnaires, which could be statistically analyzed. The rest of the analysis is based on usable responses.

Non-usable responses included:

- Blank questionnaires returned (not including undeliverables).
- Questionnaires from respondents who did not own any forest land at any time in the last ten years but filled the questionnaire out.
- Questionnaires from respondents who did not own any forest land in Virginia at any time in the past ten years but filled the questionnaire out.
- Questionnaires with only the demographics section completed.
- Information from respondents, who called, e-mailed or sent us letters, explaining why they did not return the questionnaire without sending a completed questionnaire back.

No response category:

This category included all respondents who did not belong to any of the two preceding categories; it included respondents who got the questionnaires but did not return it, did not contact us about why they did not return it, or returned it but it got lost in the mail.

Undeliverable (bad addresses): this category includes questionnaires that could not be delivered to the addressee and were returned to us. They were not counted as responses.

Pretest of the Questionnaire and Mode of Administration

For validity purposes, the questionnaire was pilot tested; it was mailed to 120 NIPF owners using the Dillman's (2000) tailored design method, using an advance letter that alerted them about the survey, followed by the survey package (cover letter, questionnaire, self-addressed stamped return envelope) a week later. For practical reasons, we decided to conduct the pilot test with forest owners living in Montgomery County, Virginia (the towns of Blacksburg and Christiansburg). A summary of the results of the pilot test of the questionnaire is in Appendix C.

Focus Group

After all responses from the pilot test were gathered, a focus group was held to ensure the validity of the questions (i.e. to make sure all questions were clear and understood the way we intended them to be). Respondents made comments, provided suggestions about unclear questions we identified from the pilot test results, other respondents themselves did not understand or interpreted differently. The focus group was also used to get input from respondents about the presentation of the survey (length, format, wording of questions, font size, etc.). Given the very limited number of respondents who could come to the focus group session (only two voluntary NIPF owners came out of 33 invited), the format was more of a discussion on the points that respondents and ourselves considered important. The materials used during the focus group are presented in Appendix D.

Data Collection

The survey was mailed after analysis of the pilot test, and correction and revision after the focus group. It was administered using a slightly modified version of the Dillman's tailored design method (Dillman, 2000) by using two waves of mailings of the survey packet (advance letter, cover letter, questionnaire, self-addressed stamped return envelope), and a wave of reminder cards.

The first mailing was in late April 2007. A month later, the reminder card was sent to all recipients who did not return the questionnaire. Another month passed before we sent out the second wave of mailing of the survey packet because responses kept arriving regularly during

that period. We asked recipients to return the questionnaire even if they did not fill it out, with a mention of the reason why it was not filled out. In order for us to know that they purposefully did not fill the questionnaire out, not that they lost it or some other reason.

Data Input, Preliminary Data Processing and Data Cleaning

In parallel with the data collection, we entered the data on an Excel spreadsheet, then conducted preliminary data processing using the Statistical Package for the Social Sciences (SPSS) to identify and fix any problems or mistakes made during the data entry. It was only after the data was cleaned that we proceeded to the actual data analysis.

Data Analysis

Relationships between the VFLEP and Adoption of Active Management Practices

There are three groups of NIPF owners, five groups of practices (harvesting practices, wildlife management practices, woodland management practices, best management practices, conservation easements), and three intermediate steps toward the adoption of practices (the use of a written management plan, the use of technical assistance, and the use of financial assistance). This section discusses whether there is a significant difference in terms of adoption of the eight groups of practices between the three groups we are interested in. We used a one way ANOVA using the three educational program categories as independent variable, and as dependent variables the five groups of practices, as well as the three precursor variables (written management plan, technical assistance, and financial assistance). The F statistic measures the significance of the differences between the means; a significant F statistic means that at least two groups differ from one another.

Since all of our dependent variables are dichotomous, caution should be taken when using ANOVA. Lunney (1970) conducted a study determining the appropriateness of the use of ANOVA for dichotomous dependent variables. His findings included the following: First, the ANOVA model has to be fixed, meaning that the levels of each independent variable are chosen (as opposed to being randomly selected from a population of levels for the variable). Second, if the proportion of cases in the smaller category is equal to or greater than 0.2, then, the number of degrees of freedom for error should be equal to or more than 20. Last, if the proportion of cases

in the smaller category is less than 0.2, then, the number of degrees of freedom for error should be equal to or more than 40. It is only when the first condition, and either one of the two others are met that the results derived from ANOVA, with dichotomous dependent variables can be used with great confidence (Lunney, 1970).

Since ANOVA only indicates significant differences among the means of the groups (i.e., at least two of the groups have significantly different means) without specifying which group is different from others. When the ANOVA results showed significant differences in the means, we used post-hoc test to identify which groups were different from others. The method used for the post-hoc test depends on whether there is equality of variance or not in the practices across the three groups. The Levene test is used to test the equality of variance (if its result shows significant difference, then unequal variance is assumed, if not, equal variance is assumed). In the multiple comparisons table, depending on the outcome of the test of equality of variance, either the Tamhane's test (which is based on the t-test), or the Least Significant Difference (LSD) methods were used to determine which means differed. The first was used if variances were unequal and the second for equal variances. All tests used a level of significance of 0.05 to determine whether the three groups differed in the array of practices NIPF owners implemented on their lands. We used the number of groups of practices implemented as the dependent variable instead of the individual groups of practices.

Relationships between the VFLEP and the Array of Active Management Practices Adopted

VFLEP offered three different shortcourses throughout the state of Virginia from 1997 through 2004. These three shortcourses were called Woodland Options (formerly Introduction to Woodland Management); Wildlife Options (formerly Introduction to Wildlife Management); and Timber Harvesting and Marketing (formerly Introduction to Timber Marketing and Harvesting). Each of these shortcourses specifically aimed to motivate NIPF owners to adopt practices related to the content of the materials. Some of the individuals in our sample attended multiple shortcourses, not just one. We analyzed whether attendance at multiple shortcourses translated to adoption of a larger array of practices on the land in general (number of practices adopted out of the eight possible) and/or among the three specific groups of practices intended for the owner to adopt (number of practices adopted out of the three). An ANOVA test was also used for this analysis, using the VFLEP variable with its three categories (no educational programs, VFLEP attendees, and other educational program attendees) as factor and the number of practices

adopted as the dependent variable. We used ANOVA and post-hoc tests as described previously.

Results and Discussion

We classified our survey respondents into three groups: those who did not attend any educational program, those who attended at least one of the three shortcourses offered by the VFLE, and those who did not attend any of the VFLEP courses, but attended other educational programs. Table 77 shows the distribution of the respondents across the three groups.

Table 77. Distribution of the respondents across the three groups (N= 1097)

	Frequency	Percent
Owners who did not attend at any educational program (No educational program)	321	29
Owners who attended at least one of the VFLEP courses (VFLEP Attendees)	489	45
Owners who did not attend VFLEP courses but attended other programs (Other educational programs)	287	26

Demographics

The ANOVA tables (Table 78) show significant F values for all four dependent variables suggesting that at least two of the three groups of educational programs (No educational program, VFLEP attendees, other educational program attendees) differ in terms of age, level of education, income earned from forest, and household income.

Table 78. Analysis of variance for demographics

		Sum of Squares	df	Mean Square	F	Sig.
Age	Between Groups	2902.672	2	1451.336	10.155	.000
	Within Groups	151772.364	1062	142.912		
	Total	154675.037	1064			
Level of education	Between Groups	183.876	2	91.938	39.217	.000
	Within Groups	2506.091	1069	2.344		
	Total	2689.966	1071			
% income from forest	Between Groups	625.382	2	312.691	3.863	.021
	Within Groups	80461.458	994	80.947		
	Total	81086.841	996			
Household income	Between Groups	23.497	2	11.749	9.994	.000
	Within Groups	1121.433	954	1.176		
	Total	1144.930	956			

Table 79 suggests that all three groups have equal variances in terms of age, suggesting the use of Fisher's least significant difference (LSD) but have unequal variances in terms of level of education, percentage of income earned from forest, and household income, which suggests the use of the Tamhane test to identify which groups differ from others.

Table 79. Test of homogeneity of variances for demographics

	Levene Statistic	df1	df2	Sig.
Age	.829	2	1062	.437
Level of education	19.685	2	1069	.000
% income from forest	3.791	2	994	.023
Household income	3.252	2	954	.039

The multiple comparisons table (Table 80) shows that owners who did not attend any educational program were significantly older than those who attended the VFLEP program, themselves older than owners who attended other educational programs. In other words, on the age continuum, we have from the youngest to the oldest: owners who attended other educational programs, VFLEP attendees, and owners who did not attend any program. Also, from the most educated to the least educated, we have VFLEP attendees and owners who attended other programs statistically equally educated and more educated than owners who did not attend any educational program. Considering that the fact of attending educational program is a behavior resulting from a favorable attitude toward the implementation of sustainable forestry practices, our results confirmed Arano et al. (2005), Potter-Witter (2005), and Blatner et al. (1991) who found that owners who adopted behavior related to sustainable forest management tended to be younger and have higher level of educational attainment compared to those who did not; Blatner et al. (1991) also reached the same conclusions. Also, owners who attended other programs than the VFLEP tended to earn more proportion of their total income from their forest compared to those who attended the VFLEP program while owners who did not attend any educational program did not earn either significantly more than VFLEP attendees or significantly less than other programs attendees either. Owners who did not attend any educational programs earn significantly less money compared to the two other groups, which earn statistically the same amount of annual household income; which also confirmed both Blatner et al. (1991) and Arano et al. (2004). The means for each group can be found in Appendix J.

Table 80. Multiple comparisons for the demographics

Dependent Variable	(I)	(J)	Mean diff (I-J)	Std. Error	Sig.
Age	No educational program	VFLEP attendees	2.187(*)	.874	.012
		Other educational programs	4.448(*)	.987	.000
	VFLEP attendees	No educational program	-2.187(*)	.874	.012
		Other educational programs	2.260(*)	.900	.012
	Other educational programs	No educational program	-4.448(*)	.987	.000
		VFLEP attendees	-2.260(*)	.900	.012
Level of education	No educational program	VFLEP attendees	-.801(*)	.118	.000
		Other educational programs	-1.039(*)	.128	.000
	VFLEP attendees	No educational program	.801(*)	.118	.000
		Other educational programs	-.238	.108	.081
	Other educational programs	No educational program	1.039(*)	.128	.000
		VFLEP attendees	.238	.108	.081
% income from forest	No educational program	VFLEP attendees	-.212	.698	.986
		Other educational programs	-1.911	.828	.063
	VFLEP attendees	No educational program	.212	.698	.986
		Other educational programs	-1.699(*)	.700	.046
	Other educational programs	No educational program	1.911	.828	.063
		VFLEP attendees	1.699(*)	.700	.046
Household income	No educational program	VFLEP attendees	-.247(*)	.088	.016
		Other educational programs	-.420(*)	.096	.000
	VFLEP attendees	No educational program	.247(*)	.088	.016
		Other educational programs	-.173	.082	.100
	Other educational programs	No educational program	.420(*)	.096	.000
		VFLEP attendees	.173	.082	.100

Characteristics

The ANOVA tables (Table 81) show that at least two of the three groups differed in terms of land size owned and the self-rated attitude toward adoption; while no significant difference was found in terms of absenteeism (i.e. all three groups have the same absenteeism rate).

Table 81. Analysis of variance for characteristics

		Sum of Squares	df	Mean Square	F	Sig.
Acreage	Between Groups	1801641.25	2	900820.62	9.96	.000
	Within Groups	92620325.10	1025	90361.3		
	Total	94421966.36	1027			
Distance home-forest	Between Groups	50784.02	2	25392.01	.64	.523
	Within Groups	35576889.33	910	39095.48		
	Total	35627673.35	912			
Self-rated adoption attitude	Between Groups	81.90	2	40.95	20.17	.000
	Within Groups	2017.72	994	2.03		
	Total	2099.63	996			

The test of homogeneity of variances (Table 82) shows that both land size and the self-rated attitude toward innovation have unequal variances across the three groups; implying the use of the Tamhane test to identify which group differ from others.

Table 82. Test of homogeneity of variances for characteristics

	Levene Statistic	df1	df2	Sig.
Acreage	14.512	2	1025	.000
Distance home-forest	1.832	2	910	.161
Self-rated adoption attitude	5.242	2	994	.005

The multiple comparisons table (Table 83) shows that VFLEP attendees owned significantly more land than the two other groups, in which owners had statistically equal land sizes. This is only partly consistent with Blatner et al. (1991) findings, saying that owners who received some sort of assistance (educational and/or technical) tended to own larger forest lands because one of the two groups of owners who attended educational programs did actually not differ from owners who did not attend any. Owners who did not attend any educational program tended to rate themselves as being more reluctant to innovations compared to the two other groups, in which owners rated themselves equally but statistically more favorable to innovation. These results confirm the reliability of our measures about the concept though it was self-rated.

Table 83. Multiple comparisons for characteristics

Dependent Variable	(I)	(J)	Mean diff. (I-J)	Sig.
Acreage	No educational program	VFLEP attendees	-84.598(*)	.000
		Other educational programs	-.829	1.000
	VFLEP attendees	No educational program	84.598(*)	.000
		Other educational programs	83.769(*)	.001
	Other educational programs	No educational program	.829	1.000
		VFLEP attendees	-83.769(*)	.001
Self-rated adoption attitude	No educational program	VFLEP attendees	-.563(*)	.000
		Other educational programs	-.731(*)	.000
	VFLEP attendees	No educational program	.563(*)	.000
		Other educational programs	-.169	.293
	Other educational programs	No educational program	.731(*)	.000
		VFLEP attendees	.169	.293

* The mean difference is significant at the .05 level.

Motivations

The ANOVA tables (Table 84) show that there were significant differences between the three groups in terms of amenity motivations and economic motivations. In contrast, they did not differ in terms of farming-related motivations and recreation motivations; suggesting that educational programs did not have any relationship with owners' motivations in these two aspects.

Table 84. Analysis of variance for motivations

		Sum of Squares	df	Mean Square	F	Sig.
Amenity motivations	Between Groups	9.04	2	4.52	4.552	.011
	Within Groups	1073.95	1081	.99		
	Total	1083.00	1083			
Economic motivations	Between Groups	52.23	2	26.11	27.391	.000
	Within Groups	1030.76	1081	.95		
	Total	1083.00	1083			
Farming-related motivations	Between Groups	.04	2	.02	.024	.977
	Within Groups	1082.95	1081	1.00		
	Total	1083.00	1083			
Recreation motivations	Between Groups	3.52	2	1.76	1.762	.172
	Within Groups	1079.48	1081	.99		
	Total	1083.00	1083			

The test of homogeneity of variances (Table 85) shows that the three groups had unequal variances in terms of amenity motivations (implying the use of the Tamhane test for multiple comparisons), but had equal variances in terms of economic motivations (implying the use of Fisher's LSD test for multiple comparisons).

Table 85. Test of homogeneity of variances for motivations

	Levene Statistic	df1	df2	Sig.
Amenity motivations	6.46	2	1081	.002
Economic motivations	.49	2	1081	.608

The multiple comparisons table (Table 86) shows that both groups of owners who attended educational programs had statistically equal motivations for amenity values for owning their forest, but higher compared to owners who did not attend any educational program. These findings are going along with Koontz (2001) who found that programs aimed at non-monetary benefits (amenity values) would more likely succeed with owners who are younger, have higher income, and higher educational attainment; which characteristics actually describe owners who attended educational programs in our study. In contrast, VFLEP attendees had higher economic motivations compared to the two other groups, which had statistically equal economic motivations, but lower than VFLEP attendees. This is also consistent to Blatner et al. (1991) who said that owners who received management assistance placed more importance on managing forest land for economic purposes compared to those who did not receive any assistance.

Table 86. Multiple comparisons for motivations

Dependent Variable	(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Amenity motivations	No educational program	VFLEP attendees	-.21620(*)	.07452	.012
		Other educational programs	-.10460	.08521	.526
	VFLEP attendees	No educational program	.21620(*)	.07452	.012
		Other educational programs	.11160	.07284	.333
	Other educational programs	No educational program	.10460	.08521	.526
		VFLEP attendees	-.11160	.07284	.333
Economic motivations	No educational program	VFLEP attendees	-.44456(*)	.07081	.000
		Other educational programs	-.00685	.08001	.932
	VFLEP attendees	No educational program	.44456(*)	.07081	.000
		Other educational programs	.43771(*)	.07283	.000
	Other educational programs	No educational program	.00685	.08001	.932
		VFLEP attendees	-.43771(*)	.07283	.000

* The mean difference is significant at the .05 level.

Information providers

Table 87 suggest that at least two of the three groups differed in terms of use of all information providers except for lawn/garden companies, local government, and TV/radio (meaning that all three groups did not differ in their use of these three information providers).

Table 87. Analysis of variance for information providers

		Sum of squares	df	Mean square	F	Sig.
VDOF	Between Groups	43.12	2	21.56	103.23	.000
	Within Groups	222.45	1065	.20		
	Total	265.57	1067			
Lawn/garden company	Between Groups	.01	2	.00	.20	.816
	Within Groups	31.02	1065	.02		
	Total	31.04	1067			
Arborist	Between Groups	.41	2	.20	5.73	.003
	Within Groups	38.09	1065	.03		
	Total	38.50	1067			
Extension forester/university employee	Between Groups	7.43	2	3.71	23.43	.000
	Within Groups	168.99	1065	.15		
	Total	176.43	1067			
Private consultant	Between Groups	11.24	2	5.62	31.67	.000
	Within Groups	189.00	1065	.17		
	Total	200.25	1067			
Company forester	Between Groups	2.403	2	1.202	14.37	.000
	Within Groups	89.045	1065	.084		
	Total	91.449	1067			
Local government	Between Groups	.020	2	.010	.45	.637
	Within Groups	23.441	1065	.022		
	Total	23.461	1067			
Logging contractor	Between Groups	.621	2	.310	3.73	.024
	Within Groups	88.387	1065	.083		
	Total	89.007	1067			
Other landowners	Between Groups	3.042	2	1.521	13.82	.000
	Within Groups	117.127	1065	.110		
	Total	120.169	1067			
Friends/family/neighbors	Between Groups	1.695	2	.847	7.61	.001
	Within Groups	118.474	1065	.111		
	Total	120.169	1067			
TV/radio	Between Groups	.049	2	.025	.92	.396
	Within Groups	28.164	1065	.026		
	Total	28.213	1067			
Magazine/newspaper/newsletter	Between Groups	8.510	2	4.255	26.79	.000
	Within Groups	169.089	1065	.159		
	Total	177.598	1067			
Conservation organizations	Between Groups	3.348	2	1.674	16.42	.000
	Within Groups	108.550	1065	.102		
	Total	111.898	1067			
Internet	Between Groups	2.581	2	1.291	13.73	.000
	Within Groups	100.036	1065	.094		
	Total	102.617	1067			

The Levene Statistic values (Table 88) imply that all the variances were unequal across the three groups, implying the use of the Tamhane test for all multiple comparisons.

Table 88. Test of homogeneity of variances for information providers

	Levene Statistic	df1	df2	Sig.
VDOF	106.379	2	1065	.000
Arborist	24.925	2	1065	.000
Extension forester/university employee	137.644	2	1065	.000
Private consultant	132.859	2	1065	.000
Company forester	62.979	2	1065	.000
Logging contractor	14.773	2	1065	.000
Other landowners	62.103	2	1065	.000
Friends/family/neighbors	34.458	2	1065	.000
Magazine/newspaper/newsletter	113.335	2	1065	.000
Conservation organizations	77.297	2	1065	.000
Internet	62.116	2	1065	.000

The multiple comparisons table (Table 94) implies that owners who attended other programs used the VDOF, private consultants, company foresters, magazine/newspapers/ newsletter significantly more than VFLEP attendee owners; themselves used these providers significantly more than owners who did not attend any educational program. VFLEP attendees and other programs attendees used the services of Extension foresters, arborists, other landowners, family, friends, neighbors, internet, and conservation organizations equally, but they used them significantly more compared to owners who did not attend any educational program. Other program attendees used the services of logging contractor significantly more than owners who did not attend any educational program; VFLEP attendees did not use the services of these providers differently from either of the two groups. These results confirm Downing and Finley (2005) who found that owners with higher educational attainment prefer active learning methods; thus, providers with whom they can interact with and satisfy their needs in general, not just on a very specific topic were preferred to other providers.

Table 89. Multiple comparisons for information providers

Dependent Variable	(I)	(J)	Mean diff. (I-J)	Std. err	Sig.
VDOF	No educational program	VFLEP attendees	-.283(*)	.034	.000
		Other educational programs	-.539(*)	.035	.000
	VFLEP attendees	No educational program	.283(*)	.034	.000
		Other educational programs	-.257(*)	.033	.000
	Other educational programs	No educational program	.539(*)	.035	.000
		VFLEP attendees	.257(*)	.033	.000
Arborist	No educational program	VFLEP attendees	-.042(*)	.011	.000
		Other educational programs	-.046(*)	.014	.003
	VFLEP attendees	No educational program	.042(*)	.011	.000
		Other educational programs	-.004	.016	.993
	Other educational programs	No educational program	.046(*)	.014	.003
		VFLEP attendees	.004	.016	.993
Extension forester/university employee	No educational program	VFLEP attendees	-.169(*)	.025	.000
		Other educational programs	-.204(*)	.031	.000
	VFLEP attendees	No educational program	.169(*)	.025	.000
		Other educational programs	-.034	.033	.659
	Other educational programs	No educational program	.204(*)	.031	.000
		VFLEP attendees	.034	.033	.659
Private consultant	No educational program	VFLEP attendees	-.130(*)	.027	.000
		Other educational programs	-.276(*)	.034	.000
	VFLEP attendees	No educational program	.130(*)	.027	.000
		Other educational programs	-.146(*)	.035	.000
	Other educational programs	No educational program	.276(*)	.034	.000
		VFLEP attendees	.146(*)	.035	.000
Company forester	No educational program	VFLEP attendees	-.062(*)	.017	.001
		Other educational programs	-.127(*)	.024	.000
	VFLEP attendees	No educational program	.062(*)	.017	.001
		Other educational programs	-.066(*)	.026	.030
	Other educational programs	No educational program	.127(*)	.024	.000
		VFLEP attendees	.066(*)	.026	.030
Logging contractor	No educational program	VFLEP attendees	-.021	.019	.632
		Other educational programs	-.063(*)	.024	.029
	VFLEP attendees	No educational program	.021	.019	.632
		Other educational programs	-.043	.024	.198
	Other educational programs	No educational program	.063(*)	.024	.029
		VFLEP attendees	.043	.024	.198
Dependent Variable	(I)	(J)	Mean diff. (I-J)	Std. err	Sig.
Other landowners	No educational program	VFLEP attendees	-.079(*)	.020	.000
		Other educational programs	-.143(*)	.027	.000
	VFLEP attendees	No educational program	.079(*)	.020	.000
		Other educational programs	-.064	.028	.070
	Other educational programs	No educational program	.143(*)	.027	.000
		VFLEP attendees	.064	.028	.070
Friends/family/neighbors	No educational program	VFLEP attendees	-.074(*)	.022	.002
		Other educational programs	-.102(*)	.027	.000
	VFLEP attendees	No educational program	.074(*)	.022	.002
		Other educational programs	-.028	.027	.672
	Other educational programs	No educational program	.102(*)	.027	.000
		VFLEP attendees	.028	.027	.672
Magazine/newspaper/newsletter	No educational program	VFLEP attendees	-.108(*)	.025	.000
		Other educational programs	-.240(*)	.033	.000
	VFLEP attendees	No educational program	.108(*)	.025	.000
		Other educational programs	-.132(*)	.034	.000
	Other educational programs	No educational program	.240(*)	.033	.000
		VFLEP attendees	.132(*)	.034	.000

Conservation organizations	No educational program	VFLEP attendees	-.089(*)	.019	.000
		Other educational programs	-.149(*)	.026	.000
	VFLEP attendees	No educational program	.089(*)	.019	.000
		Other educational programs	-.060	.028	.090
	Other educational programs	No educational program	.149(*)	.026	.000
		VFLEP attendees	.060	.028	.090
Internet	No educational program	VFLEP attendees	-.074(*)	.018	.000
		Other educational programs	-.131(*)	.025	.000
	VFLEP attendees	No educational program	.074(*)	.018	.000
		Other educational programs	-.057	.027	.092
	Other educational programs	No educational program	.131(*)	.025	.000
		VFLEP attendees	.057	.027	.092

* The mean difference is significant at the .05 level.

Information Channels

The ANOVA tables (Table 90) show that at least two of the three groups were different from one another in terms of their perception of all twelve information channels for managing their land.

Table 90. Analysis of variance for information channels

		Sum of squares	df	Mean square	F	Sig.
Books	Between Groups	27.99	2	13.99	10.56	.000
	Within Groups	1009.11	762	1.32		
	Total	1037.10	764			
Newsletter/magazine/newspaper	Between Groups	34.41	2	17.20	11.96	.000
	Within Groups	1096.20	762	1.43		
	Total	1130.62	764			
Internet	Between Groups	20.06	2	10.03	4.43	.012
	Within Groups	1723.40	762	2.26		
	Total	1743.46	764			
Conferences	Between Groups	104.87	2	52.43	25.88	.000
	Within Groups	1543.59	762	2.02		
	Total	1648.46	764			
DVD/video	Between Groups	22.64	2	11.32	5.07	.006
	Within Groups	1699.31	762	2.23		
	Total	1721.95	764			
TV/radio	Between Groups	13.93	2	6.96	3.63	.027
	Within Groups	1462.51	762	1.91		
	Total	1476.45	764			
Fieldtrips	Between Groups	144.12	2	72.06	34.89	.000
	Within Groups	1573.57	762	2.06		
	Total	1717.69	764			
Workshop/shortcourse	Between Groups	266.21	2	133.10	72.66	.000
	Within Groups	1395.74	762	1.83		
	Total	1661.95	764			
Natural resource professional	Between Groups	96.29	2	48.14	31.17	.000
	Within Groups	1176.95	762	1.54		
	Total	1273.24	764			
Peers	Between Groups	48.18	2	24.09	12.21	.000
	Within Groups	1502.59	762	1.97		
	Total	1550.77	764			
Logging contractor	Between Groups	24.48	2	12.24	6.35	.002
	Within Groups	1467.12	762	1.92		
	Total	1491.60	764			
Owner organization	Between Groups	37.47	2	18.73	9.14	.000
	Within Groups	1561.53	762	2.04		
	Total	1599.01	764			

The Levene Statistic values (Table 91) show that the three groups have equal variances for internet, DVD/video, TV/radio, and logging contractor, implying the use of the Fisher's LSD test for the multiple comparisons; the groups have unequal variances for the rest of the information channels, implying the use of the Tamhane test for the multiple comparisons.

Table 91. Test of homogeneity of variances for information channels

	Levene Statistic	df1	df2	Sig.
Books	8.183	2	762	.000
Newsletter/magazine/newspaper	11.686	2	762	.000
Internet	.319	2	762	.727
Conferences	4.562	2	762	.011
DVD/video	.017	2	762	.983
TV/radio	.344	2	762	.709
Fieldtrips	5.512	2	762	.004
Workshop/shortcourse	8.522	2	762	.000
Natural resource professional	36.012	2	762	.000
Peers	5.942	2	762	.003
Logging contractor	.431	2	762	.650
Owner organization	7.199	2	762	.001

The multiple comparisons table (Table 92) implies that both VFLEP attendees and other educational program attendees rated the importance of all twelve information channels equally, and they rated each of them as being more useful than did owners who did not attend any program. These results also confirm prior studies that stated that owners who are interested to apply the knowledge they get from information providers tended to value the information they get compared to less active owners (Downing and Finley, 2005).

Table 92. Multiple comparisons for information channels

Dependent Variable	(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Books	No educational program	VFLEP attendees	-.413(*)	.127	.004
		Other educational programs	-.529(*)	.128	.000
	VFLEP attendees	No educational program	.413(*)	.127	.004
		Other educational programs	-.116	.087	.457
	Other educational programs	No educational program	.529(*)	.128	.000
		VFLEP attendees	.116	.087	.457
Newsletter/magazine/newspaper	No educational program	VFLEP attendees	-.463(*)	.129	.001
		Other educational programs	-.584(*)	.132	.000
	VFLEP attendees	No educational program	.463(*)	.129	.001
		Other educational programs	-.122	.093	.473
	Other educational programs	No educational program	.584(*)	.132	.000
		VFLEP attendees	.122	.093	.473
Internet	No educational program	VFLEP attendees	-.427(*)	.146	.004
		Other educational programs	-.362(*)	.154	.019
	VFLEP attendees	No educational program	.427(*)	.146	.004
		Other educational programs	.065	.123	.599
	Other educational programs	No educational program	.362(*)	.154	.019
		VFLEP attendees	-.065	.123	.599

Dependent Variable	(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Conferences	No educational program	VFLEP attendees	-.862(*)	.128	.000
		Other educational programs	-.991(*)	.134	.000
	VFLEP attendees	No educational program	.862(*)	.128	.000
		Other educational programs	-.129	.119	.624
	Other educational programs	No educational program	.991(*)	.134	.000
		VFLEP attendees	.129	.119	.624
DVD/video	No educational program	VFLEP attendees	-.426(*)	.145	.003
		Other educational programs	-.438(*)	.152	.004
	VFLEP attendees	No educational program	.426(*)	.145	.003
		Other educational programs	-.012	.122	.919
	Other educational programs	No educational program	.438(*)	.152	.004
		VFLEP attendees	.012	.122	.919
TV/radio	No educational program	VFLEP attendees	-.320(*)	.134	.017
		Other educational programs	-.357(*)	.141	.012
	VFLEP attendees	No educational program	.320(*)	.134	.017
		Other educational programs	-.037	.113	.746
	Other educational programs	No educational program	.357(*)	.141	.012
		VFLEP attendees	.037	.113	.746
Fieldtrips	No educational program	VFLEP attendees	-.991(*)	.142	.000
		Other educational programs	-1.174(*)	.146	.000
	VFLEP attendees	No educational program	.991(*)	.142	.000
		Other educational programs	-.184	.116	.303
	Other educational programs	No educational program	1.174(*)	.146	.000
		VFLEP attendees	.184	.116	.303
Workshop/shortcourse	No educational program	VFLEP attendees	-1.430(*)	.136	.000
		Other educational programs	-1.534(*)	.141	.000
	VFLEP attendees	No educational program	1.430(*)	.136	.000
		Other educational programs	-.103	.109	.715
	Other educational programs	No educational program	1.534(*)	.141	.000
		VFLEP attendees	.103	.109	.715
Natural resource professional	No educational program	VFLEP attendees	-.863(*)	.143	.000
		Other educational programs	-.919(*)	.147	.000
	VFLEP attendees	No educational program	.863(*)	.143	.000
		Other educational programs	-.056	.093	.908
	Other educational programs	No educational program	.919(*)	.147	.000
		VFLEP attendees	.056	.093	.908
Peers	No educational program	VFLEP attendees	-.553(*)	.142	.000
		Other educational programs	-.689(*)	.148	.000
	VFLEP attendees	No educational program	.553(*)	.142	.000
		Other educational programs	-.136	.113	.540
	Other educational programs	No educational program	.689(*)	.148	.000
		VFLEP attendees	.136	.113	.540
Logging contractor	No educational program	VFLEP attendees	-.338(*)	.135	.012
		Other educational programs	-.504(*)	.142	.000
	VFLEP attendees	No educational program	.338(*)	.135	.012
		Other educational programs	-.167	.113	.142
	Other educational programs	No educational program	.504(*)	.142	.000
		VFLEP attendees	.167	.113	.142
Owner organization	No educational program	VFLEP attendees	-.511(*)	.129	.000
		Other educational programs	-.595(*)	.138	.000
	VFLEP attendees	No educational program	.511(*)	.129	.000
		Other educational programs	-.085	.120	.861
	Other educational programs	No educational program	.595(*)	.138	.000
		VFLEP attendees	.085	.120	.861

Constraints to active forest management

The ANOVA tables (Table 93) show that at least two groups differ in their perception of the importance of human-related, scale-related, and financial constraints; however, they did not differ in terms of time/labor constraints.

Table 93. Analysis of variance for constraints to active forest management

		Sum of squares	df	Mean Square	F	Sig.
Human-related constraints	Between Groups	13.94	2	6.97	7.058	.001
	Within Groups	956.05	968	.98		
	Total	970.00	970			
Scale-related constraints	Between Groups	9.31	2	4.65	4.692	.009
	Within Groups	960.68	968	.99		
	Total	970.00	970			
Financial constraints	Between Groups	7.51	2	3.75	3.778	.023
	Within Groups	962.48	968	.99		
	Total	970.00	970			
Time/labor constraints	Between Groups	4.80	2	2.40	2.410	.090
	Within Groups	965.19	968	.99		
	Total	970.00	970			

Table 94 suggests that the three groups had equal variances for human-related and financial constraints, implying the use of the Fisher's LSD; in contrast, they had unequal variances for scale-related constraints.

Table 94. Test of homogeneity of variances for constraints to active forest management

	Levene Statistic	df1	df2	Sig.
Human-related constraints	2.601	2	968	.075
Scale-related constraints	3.350	2	968	.036
Financial constraints	.729	2	968	.483

The multiple comparisons tables (Table 95) suggest that: first, owners who did not attend any program, and those who attended any of the VFLEP courses did not differ in their perception of the human-related constraints; both groups rated human-related constraints as less limiting to active forest management compared to owners who attended other educational programs. Also, VFLEP attendees and other educational programs rated scale-related constraints as more limiting to active forest management than did owners who did not attend any educational program. As we

saw in the previous analyses, owners who attended educational programs were younger, had higher education level; and were more affluent; our results confirmed Koontz (2001) who found that owners who were younger, earned more income, and had higher educational attainment tended to own smaller land, thus were limited by the economies of scale. Finally, owners who attended other educational programs perceived financial constraints as more limiting to active forest management than did owners who did not attend any educational program; VFLEP attendees did not rate financial constraints either more limiting than did other educational programs attendees, nor less limiting than did owners who did not attend any educational programs.

Table 95. Multiple comparisons for constraints to active management

Dependent Variable	(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Human-related constraints	No educational program	VFLEP attendees	-.09131	.07800	.242
		Other educational programs	-.30939(*)	.08590	.000
	VFLEP attendees	No educational program	.09131	.07800	.242
		Other educational programs	-.21808(*)	.07639	.004
	Other educational programs	No educational program	.30939(*)	.08590	.000
		VFLEP attendees	.21808(*)	.07639	.004
Scale-related constraints	No educational program	VFLEP attendees	-.20754(*)	.08078	.031
		Other educational programs	-.23835(*)	.08561	.017
	VFLEP attendees	No educational program	.20754(*)	.08078	.031
		Other educational programs	-.03081	.07398	.966
	Other educational programs	No educational program	.23835(*)	.08561	.017
		VFLEP attendees	.03081	.07398	.966
Financial constraints	No educational program	VFLEP attendees	-.12606	.07826	.108
		Other educational programs	-.23687(*)	.08619	.006
	VFLEP attendees	No educational program	.12606	.07826	.108
		Other educational programs	-.11082	.07665	.149
	Other educational programs	No educational program	.23687(*)	.08619	.006
		VFLEP attendees	.11082	.07665	.149

Differences in adoption between the three groups of owners

Individual Practices

The appropriateness of the use of ANOVA in our analysis depends partly on the proportions of the cases in the smaller category of the dependent variable (either adopter or non-adopter). Table 96 provides the proportions of the cases in each category.

Table 96. Proportions of adopters and non-adopters across the practices.

	Groups of practices	Non-adopter (%)	Adopter (%)	Total N
No educational programs	Harvesting practices	***19***	81	172
	Wildlife management practices	26	74	133
	Woodland management practices	25	75	259
	Best management practices (BMPs)	34	66	159
	Conservation easement programs	94	***6***	298
	Written management plan	88	***12***	299
	Technical assistance	65	35	310
	Financial assistance	91	***9***	297
VFLEP attendees	Harvesting practices	***9***	91	326
	Wildlife management practices	18	82	309
	Woodland management practices	***6***	94	455
	Best management practices (BMPs)	35	65	337
	Conservation easement programs	94	***6***	471
	Written management plan	59	41	474
	Technical assistance	27	73	488
	Financial assistance	78	22	475
Other educational programs	Harvesting practices	***8***	92	160
	Wildlife management practices	26	74	144
	Woodland management practices	***17***	83	269
	Best management practices (BMPs)	***11***	89	235
	Conservation easement programs	89	***11***	285
	Written management plan	78	22	268
	Technical assistance	56	44	285
	Financial assistance	64	36	284

Table 96 shows that: first, the first level of the independent variable (no educational program), presented four practices (harvesting practices, conservation easement programs, written management plan, and financial assistance) have the smaller category's proportion under 20%. Second, for the second level of the independent variable (VFLEP attendees), there are also four practices that have cases in the smaller category less than 20%, including harvesting practices, wildlife management practices, woodland management practices, and conservation easement programs. Finally, for the third level of the independent variable (other educational program), there are four practices having less than 20% of the cases in the smaller category (harvesting practices, woodland management practices, BMPs, and conservation easement programs). However, Table 102 shows the degrees of freedom for error in the ANOVAs range from df= 583 to df= 1080; which are much higher than the df= 40 required for the appropriateness of use of ANOVA suggested by Lunney (1970). These facts suggest that we can be confident in using ANOVA for our analysis.

Table 97 shows that for seven out of eight groups of practices, at least two of the three groups differ in terms of adoption of the practices. However, all practices presented significant differences at the level of significance of 0.10, only wildlife management practices did not present any difference across the three groups at the level of significance of 0.05; this result means that the probability of adoption of wildlife management practices was statistically the same regardless of whether a given NIPF owner attended any of the VFLEP courses, attended any other educational programs, or did not attend any educational programs at all.

Table 97. Analysis of variance table for the three groups about SFM practices adoption.

		Sum of squares	df	Mean square	F	Sig.
Harvesting practices	Between Groups	1.419	2	.709	7.145	.001
	Within Groups	65.033	655	.099		
	Total	66.451	657			
Wildlife management practices	Between Groups	.834	2	.417	2.438	.088
	Within Groups	99.768	583	.171		
	Total	100.602	585			
Woodland management practices	Between Groups	6.129	2	3.064	27.042	.000
	Within Groups	111.055	980	.113		
	Total	117.184	982			
Use of BMPs	Between Groups	9.067	2	4.533	24.559	.000
	Within Groups	134.381	728	.185		
	Total	143.447	730			
Conservation easement programs	Between Groups	.476	2	.238	3.483	.031
	Within Groups	71.752	1051	.068		
	Total	72.228	1053			
Management plan	Between Groups	16.437	2	8.218	44.458	.000
	Within Groups	191.886	1038	.185		
	Total	208.323	1040			
Technical assistance	Between Groups	33.181	2	16.590	76.088	.000
	Within Groups	235.486	1080	.218		
	Total	268.667	1082			
Financial assistance	Between Groups	10.198	2	5.099	31.328	.000
	Within Groups	171.392	1053	.163		
	Total	181.590	1055			

The Levene's test of homogeneity of variance (Table 98) shows high significance for all seven practices (not considering wildlife management practices); which means that the variances of the three groups are different for each of the seven practices considered. This suggests the use of the Tamhane's test for the multiple comparisons to identify group differences.

Table 98. Test of homogeneity of variances among the three educational groups about the adoption of SFM practices.

	Levene statistic	df1	df2	Sig.
Harvesting practices	26.672	2	655	.000
Woodland management practices	123.113	2	980	.000
Use of BMPs	161.232	2	728	.000
Conservation easement programs	13.547	2	1051	.000
Management plan	202.230	2	1038	.000
Technical assistance	36.727	2	1080	.000
Financial assistance	136.341	2	1053	.000

The multiple comparisons test (Table 99) provides us the following information:

- There was no difference between VFLEP attendees and other educational programs attendees in terms of adoption of harvesting practices; however, both of these two groups differ and are more likely to adopt harvesting practices compared to owners who did not attend any kind of educational program.
- In terms of implementation of woodland management practices, there was no difference between owners who did not attend any educational program and those who attended other types of educational program; also, these two groups differed, and were less likely to adopt woodland management practices compared to owners who attended the VFLEP courses.
- The VFLEP program had no impact on bringing owners' implementation of BMP practices on their land; the likelihood of VFLEP attendees adopting BMPs was statistically the same as that of owners who did not attend any educational programs. On the other hand, other types of educational programs were effective in bringing owners to adopt BMP practices. This could be explained by the fact that none of the VFLEP courses targeted BMPs as the primary target, but there were other educational programs that did.
- There was no difference between all three groups in terms of implementation of conservation easement programs; which means that neither the VFLEP program, nor any other type of educational program were effective in bringing people to adopt conservation easement programs. Like for BMPs, none of the three VFLEP courses motivated owners to use conservation easements.
- In terms of the use of a written management plan, all three groups differ from one another, with VFLEP attendees being the group most likely to use a written management plan,

followed by owners who attended some other type of educational programs, and the group of owners who did not attend any educational program is the least likely to use a written management plan.

- The category of VFLEP attendees was significantly more likely to seek technical assistance than the two other categories. The two other categories were not different from one another.

The three groups were all different from one another for the use of financial assistance, with the group of owners who attended other educational programs were the most likely to use financial assistance; followed by the group of owners who attended at least one of the three VFLEP courses. Owners who did not attend any educational program were the least likely to use financial assistance. These results suggest that the VFLEP program was effective in motivating owners to use financial assistance (compared to the baseline of owners who did not attend any educational programs), but was not as effective as other educational programs. This could explained by the fact that at the time of this study, financial assistance was not emphasized much in the three VFLEP courses, a separate shortcourse called “Financial Assistance Options for Landowners” was developed and first offered to owners by VFLEP program in 2005 but was not part of this study.

Table 99. Multiple comparisons of the three educational groups about adoption of practices.

Dependent variable	(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Harvesting practices	No educational program (mean: .81)	VFLEP attendees	-.103(*)	.034	.008
		Other educational program	-.111(*)	.037	.009
	VFLEP attendees (mean: .91)	No educational program	.103(*)	.034	.008
		Other educational program	-.008	.027	.988
	Other educational program (mean: .92)	No educational program	.111(*)	.037	.009
		VFLEP attendees	.008	.027	.988
Woodland management practices	No educational program (mean: .75)	VFLEP attendees	-.188(*)	.029	.000
		Other educational program	-.080	.035	.070
	VFLEP attendees (mean: .94)	No educational program	.188(*)	.029	.000
		Other educational program	.108(*)	.025	.000
	Other educational program (mean: .83)	No educational program	.080	.035	.070
		VFLEP attendees	-.108(*)	.025	.000
Use of BMPs	No educational program (mean: 66)	VFLEP attendees	.008	.046	.998
		Other educational program	-.233(*)	.043	.000
	VFLEP attendees (mean: 65)	No educational program	-.008	.046	.998
		Other educational program	-.241(*)	.033	.000
	Other educational program (mean: 89)	No educational program	.233(*)	.043	.000
		VFLEP attendees	.241(*)	.033	.000
Conservation easement programs	No educational program (mean: .06)	VFLEP attendees	.004	.018	.993
		Other educational program	-.045	.023	.153
	VFLEP attendees (mean: .06)	No educational program	-.004	.018	.993
		Other educational program	-.049	.021	.064
	Other educational program (mean: .11)	No educational program	.045	.023	.153
		VFLEP attendees	.049	.021	.064
Management plan	No educational program (mean: .12)	VFLEP attendees	-.290(*)	.029	.000
		Other educational program	-.107(*)	.032	.002
	VFLEP attendees (mean: .41)	No educational program	.290(*)	.029	.000
		Other educational program	.183(*)	.034	.000
	Other educational program (mean: .22)	No educational program	.107(*)	.032	.002
		VFLEP attendees	-.183(*)	.034	.000
Technical assistance	No educational program (mean: 35)	VFLEP attendees	-.388(*)	.034	.000
		Other educational program	-.090	.040	.073
	VFLEP attendees (mean: 73)	No educational program	.388(*)	.034	.000
		Other educational program	.299(*)	.036	.000
	Other educational program (mean: 44)	No educational program	.090	.040	.073
		VFLEP attendees	-.299(*)	.036	.000
Financial assistance	No educational program (mean: .09)	VFLEP attendees	-.123(*)	.025	.000
		Other educational program	-.265(*)	.033	.000
	VFLEP attendees (mean: .22)	No educational program	.123(*)	.025	.000
		Other educational program	-.142(*)	.034	.000
	Other educational program (mean: .36)	No educational program	.265(*)	.033	.000
		VFLEP attendees	.142(*)	.034	.000

Array of Practices Implemented

Another dimension to consider was the difference in the array of practices that the three groups implemented. There were a total of eight practices that each owner could implement on his/her land. Table 100 shows the number of practices implemented by owners across the three groups of educational programs.

Table 100. Descriptive statistics about the number of practices implemented across the three educational groups (N=1097).

	N	Mean	Std. Deviation	Std. Error	Minimum	Maximum
No educational program	321	2.26	1.780	.099	0	8
VFLEP attendees	489	3.84	1.650	.075	0	8
Other educational program	287	3.50	1.793	.106	0	8
Total	1097	3.29	1.853	.056	0	8

Presented in this section are the results of the ANOVA analysis of the number of practices implemented by each group. The ANOVA table (Table 101) shows that at least two of the groups differed in the number of practices implemented by owners.

Table 101. Analysis of variance across the three educational program groups in the number of practices implemented.

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	501.594	2	250.797	84.095	.000
Within Groups	3262.643	1094	2.982		
Total	3764.237	1096			

The Levene's test (Table 102) was not significant, leading to the use of the Fisher's LSD test for the multiple comparison analysis.

Table 102. Test of homogeneity of variances in number of practices implemented across the three educational groups.

Levene Statistic	df1	df2	Sig.
2.993	2	1094	.051

The table of multiple comparisons (Table 103) shows all three groups differed from one another in number of practices implemented. The VFLEP attendees were most likely to implement more

practices on the land, followed by owners who attended educational programs other than the VFLEP. Owners who did not attend any educational program implemented the fewest practices.

Table 103. Multiple comparisons for the three groups of educational programs in number of practices implemented.

(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
No educational program	VFLEP attendees	-1.581(*)	.124	.000
(mean: 2.26)	Other educational program	-1.240(*)	.140	.000
VFLEP attendees	No educational program	1.581(*)	.124	.000
(mean: 3.84)	Other educational program	.341(*)	.128	.008
Other educational program	No educational program	1.240(*)	.140	.000
(mean: 3.50)	VFLEP attendees	-.341(*)	.128	.008

* The mean difference is significant at the .05 level.

Relationships Between the VFLEP Shortcourses and Adoption of Practices

Three shortcourses were offered under VFLEP: Woodland Options, Timber Harvesting and Marketing, and Wildlife Options. Given that some owners attended more than one of the shortcourses, there are seven possible combinations of the three courses mentioned above. This section deals with analyzing differences in the adoption of the individual practices, and the number of practices implemented on the land. Table 104 shows the distribution of the group of VFLEP attendees across the seven groups of shortcourses attended.

Table 104. Distribution of the respondents across the shortcourses categories (N=489).

	Frequency	Percent
Woodland options course	159	32.5
Timber harvesting and marketing course	147	30.1
Wildlife options course	47	9.6
Woodland options and Timber harvesting and marketing courses	38	7.8
Woodland options and Wildlife options courses	40	8.2
Wildlife options and Timber harvesting and marketing courses	31	6.3
All three courses	27	5.5

Differences in terms of the individual practices

To make sure of the appropriateness of the use of ANOVA for our analysis using dichotomous dependent variables, the proportions of cases in the smaller category of the dependent variable (either adopters or non-adopters) for each of the practices and across the different categories of the independent variable (categories of shortcourses attended). Table 105 provides those proportions.

Table 105 shows that the number of practices having proportions of cases in the smaller category (either adopter or non-adopter) are four for woodland options, three for timber harvesting and marketing, four for wildlife options, five for woodland options and timber harvesting and marketing combined, four for woodland options and wildlife options combined, four for wildlife options and timber harvesting and marketing combined; and five for all three shortcourses combined.

Table 105. Adopters and non-adopters of practices depending on the courses taken (%).

Courses	Practices	Non-adopter (%)	Adopter (%)	TOTAL
Woodland options	Harvesting practices	**6**	94	97
	Wildlife management practices	**15**	85	98
	Woodland management practices	**6**	94	146
	Best management practices (BMPs)	32	68	106
	Conservation easement programs	94	**6**	151
	Written management plan	55	45	154
	Technical assistance	26	74	159
	Financial assistance	80	20	152
Timber harvesting	Harvesting practices	**11**	89	106
	Wildlife management practices	23	77	88
	Woodland management practices	**8**	92	134
	Best management practices (BMPs)	29	71	101
	Conservation easement programs	94	**6**	143
	Written management plan	62	38	143
	Technical assistance	29	71	147
	Financial assistance	77	23	145
Wildlife options	Harvesting practices	**8**	92	25
	Wildlife management practices	29	71	28
	Woodland management practices	**7**	93	41
	Best management practices (BMPs)	44	56	27
	Conservation easement programs	93	**7**	45
	Written management plan	74	26	43
	Technical assistance	35	65	46
	Financial assistance	87	**13**	45
Woodland options and timber harvesting	Harvesting practices	**0**	100	25
	Wildlife management practices	**15**	85	27
	Woodland management practices	**3**	97	37
	Best management practices (BMPs)	44	56	27
	Conservation easement programs	100	**0**	38
	Written management plan	55	45	38
	Technical assistance	29	71	38
	Financial assistance	84	**16**	38
Woodland options and wildlife options	Harvesting practices	**17**	83	29
	Wildlife management practices	**16**	84	25
	Woodland management practices	**3**	98	40
	Best management practices (BMPs)	41	59	29
	Conservation easement programs	95	**5**	40
	Written management plan	64	36	39
	Technical assistance	28	73	40
	Financial assistance	80	20	40
Wildlife options and timber harvesting	Harvesting practices	**9**	91	23
	Wildlife management practices	26	74	23
	Woodland management practices	**6**	94	31
	Best management practices (BMPs)	23	77	26
	Conservation easement programs	86	14	29
	Written management plan	65	35	31
	Technical assistance	**10**	90	31
	Financial assistance	67	33	30
All three courses	Harvesting practices	**10**	90	21
	Wildlife management practices	**0**	100	20
	Woodland management practices	**0**	100	26
	Best management practices (BMPs)	57	43	21
	Conservation easement programs	92	**8**	25
	Written management plan	35	65	26
	Technical assistance	**15**	85	27
	Financial assistance	60	40	25

The ANOVA table (Table 106) shows the degrees of freedom for error for each practice ranging from df= 302 to df= 481, which are far higher than the df= 40 required for the appropriateness of use of the ANOVA technique for our analysis. Table 106 also shows that for all eight practices, the seven categories of VFLEP did not differ from one another in terms of likelihood of adoption, except for the use of a written management plan at a level of significance of 0.05, and for both the use of a written management plan and BMPs at the level of significance of 0.10.

Table 106. Analysis of variance table for the individual practices across the seven categories of courses.

		Sum of squares	df	Mean square	F	Sig.
Harvesting practices	Between Groups	.536	6	.089	1.102	.361
	Within Groups	25.884	319	.081		
	Total	26.420	325			
Wildlife management practices	Between Groups	1.410	6	.235	1.575	.154
	Within Groups	45.075	302	.149		
	Total	46.485	308			
Woodland management practices	Between Groups	.256	6	.043	.761	.601
	Within Groups	25.142	448	.056		
	Total	25.398	454			
Use of BMPs	Between Groups	2.486	6	.414	1.850	.089
	Within Groups	73.894	330	.224		
	Total	76.380	336			
Conservation easement programs	Between Groups	.331	6	.055	.985	.435
	Within Groups	26.004	464	.056		
	Total	26.335	470			
Technical assistance	Between Groups	1.699	6	.283	1.454	.192
	Within Groups	93.670	481	.195		
	Total	95.369	487			
Management plan	Between Groups	3.186	6	.531	2.230	.039
	Within Groups	111.229	467	.238		
	Total	114.416	473			
Financial assistance	Between Groups	1.777	6	.296	1.757	.106
	Within Groups	78.888	468	.169		
	Total	80.665	474			

The Levene's test of homogeneity of variances (Table 107) suggests that the variances of the seven categories are significantly different, which suggests the use of the Tamhane's test for the multiple comparisons to determine which categories differ from others.

Table 107. Levene's test of homogeneity of variances across the seven categories of courses.

	Levene statistic	df1	df2	Sig.
Management plan	5.815	6	467	.000

The multiple comparisons table suggests that only the category of owners who attended all three courses differed from owners who attended wildlife options (Table 108) in terms of use of a written management plan.

Table 108. Multiple comparisons of the seven categories of courses in adoption of practices.

Dependent Variable: Management plan

(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Woodland opt. course	Harvesting course	.070	.057	.994
(mean: .45)	Wildlife opt. course	.192	.078	.296
	Woodland opt. and harvesting courses	.001	.091	1.000
	Woodland opt. and wildlife opt. courses	.089	.088	1.000
	Wildlife opt. and harvesting courses	.093	.096	1.000
	All three courses	-.206	.103	.690
Harvesting course	Woodland opt. course	-.070	.057	.994
(mean: .38)	Wildlife opt. course	.122	.079	.940
	Woodland opt. and harvesting courses	-.070	.091	1.000
	Woodland opt. and wildlife opt. courses	.019	.088	1.000
	Wildlife opt. and harvesting courses	.023	.096	1.000
	All three courses	-.276	.103	.215
Wildlife opt. course	Woodland opt. course	-.192	.078	.296
(mean: .26)	Harvesting course	-.122	.079	.940
	Woodland opt. and harvesting courses	-.192	.106	.803
	Woodland opt. and wildlife opt. courses	-.103	.103	1.000
	Wildlife opt. and harvesting courses	-.099	.110	1.000
	All three courses	-.398(*)	.117	.027
Woodland opt. and harvesting courses	Woodland opt. course	-.001	.091	1.000
(mean: 45)	Harvesting course	.070	.091	1.000
	Wildlife opt. course	.192	.106	.803
	Woodland opt. and wildlife opt. courses	.088	.113	1.000
	Wildlife opt. and harvesting courses	.093	.120	1.000
	All three courses	-.206	.125	.904
Woodland opt. and wildlife opt. courses	Woodland opt. course	-.089	.088	1.000
(mean: .36)	Harvesting course	-.019	.088	1.000
	Wildlife opt. course	.103	.103	1.000
	Woodland opt. and harvesting courses	-.088	.113	1.000
	Wildlife opt. and harvesting courses	.004	.117	1.000
	All three courses	-.295	.123	.345
Wildlife opt. and harvesting courses	Woodland opt. course	-.093	.096	1.000
(mean: 35)	Harvesting course	-.023	.096	1.000
	Wildlife opt. course	.099	.110	1.000
	Woodland opt. and harvesting courses	-.093	.120	1.000
	Woodland opt. and wildlife opt. courses	-.004	.117	1.000
	All three courses	-.299	.129	.406
All three courses	Woodland opt. course	.206	.103	.690
(mean: 75)	Harvesting course	.276	.103	.215
	Wildlife opt. course	.398(*)	.117	.027
	Woodland opt. and harvesting courses	.206	.125	.904
	Woodland opt. and wildlife opt. courses	.295	.123	.345
	Wildlife opt. and harvesting courses	.299	.129	.406

* The mean difference is significant at the .05 level.

Differences in terms of array of practices

The differences between the seven groups might also be in terms of the number of practices implemented. The first part of the following analysis involves the differences between the seven categories, taking into account all eight practices. Given that the three shortcourses targeted more specific practices, the second part of the analysis takes into account only the three practices related to the three shortcourses. Table 109 provides the number of practices implemented by owners across the seven categories of courses they took.

Table 109. Descriptive statistics about the total number of practices implemented (N=489)

	N	Mean	Std. deviation	Minimum	Maximum
Woodland options course	159	3.82	1.656	0	7
Timber harvesting and marketing course	147	3.78	1.785	0	8
Wildlife options course	47	3.11	1.684	0	6
Woodland options and Timber harvesting and marketing courses	38	3.92	1.566	1	6
Woodland options and Wildlife options courses	40	3.85	1.369	2	7
Wildlife options and Timber harvesting and marketing courses	31	4.52	1.262	1	7
All three courses	27	4.67	1.074	3	7

The ANOVA analysis was performed to determine whether there was any difference across the seven categories of courses in terms of number of practices implemented on the land. Table 110 shows that there were at least two of the seven categories that differ in terms of number of practices implemented.

Table 110. Analysis of variance for the seven categories of courses in number of practices implemented.

	Sum of squares	df	Mean square	F	Sig.
Between Groups	58.699	6	9.783	3.712	.001
Within Groups	1270.176	482	2.635		
Total	1328.875	488			

Table 111 shows the results of the test of homogeneity of variance; implying unequal variances across the seven categories, and suggesting the use of the Tamhane for the post-hoc test.

Table 111. Test of homogeneity of variances across the seven categories of courses.

Levene Statistic	df1	df2	Sig.
3.011	6	482	.007

The multiple comparisons table (Table 112) provides the following information: first, owners who attended all three shortcourses differed and implemented more practices compared to owners who attended only one course. Second, owners who attended the wildlife options and the timber harvesting and marketing shortcourses together tended to implement more practices compared to owners who attended the wildlife options shortcourse alone, but not more than those who took either woodland options, or timber harvesting and marketing alone. The rest of the categories did not differ from one another in terms of number of practices implemented on the land.

Table 112. Multiple comparisons between the seven categories of courses in number of practices implemented.

(I)	(J)	Mean diff. (I-J)	Std. error	Sig.
Woodland opt. course	Harvesting course	.042	.197	1.000
(mean: 3.82)	Wildlife opt. course	.718	.279	.224
	Woodland opt. and harvesting courses	-.097	.286	1.000
	Woodland opt. and wildlife opt. courses	-.026	.253	1.000
	Wildlife opt. and harvesting courses	-.692	.262	.204
	All three courses	-.843(*)	.245	.024
Harvesting course	Woodland opt. course	-.042	.197	1.000
(mean: 3.78)	Wildlife opt. course	.676	.286	.355
	Woodland opt. and harvesting courses	-.139	.294	1.000
	Woodland opt. and wildlife opt. courses	-.068	.262	1.000
	Wildlife opt. and harvesting courses	-.734	.270	.167
	All three courses	-.884(*)	.254	.020
Wildlife opt. course	Woodland opt. course	-.718	.279	.224
(mean: 3.11)	Harvesting course	-.676	.286	.355
	Woodland opt. and harvesting courses	-.815	.353	.396
	Woodland opt. and wildlife opt. courses	-.744	.327	.421
	Wildlife opt. and harvesting courses	-1.410(*)	.334	.001
	All three courses	-1.560(*)	.321	.000
Woodland opt. and harvesting courses	Woodland opt. course	.097	.286	1.000
(mean: 3.92)	Harvesting course	.139	.294	1.000
	Wildlife opt. course	.815	.353	.396
	Woodland opt. and wildlife opt. courses	.071	.334	1.000
	Wildlife opt. and harvesting courses	-.595	.340	.845
	All three courses	-.746	.328	.428
Woodland opt. and wildlife opt. courses	Woodland opt. course	.026	.253	1.000
(mean: 3.85)	Harvesting course	.068	.262	1.000
	Wildlife opt. course	.744	.327	.421
	Woodland opt. and harvesting courses	-.071	.334	1.000
	Wildlife opt. and harvesting courses	-.666	.313	.549
	All three courses	-.817	.299	.159
Wildlife opt. and harvesting courses	Woodland opt. course	.692	.262	.204
(mean: 4.52)	Harvesting course	.734	.270	.167
	Wildlife opt. course	1.410(*)	.334	.001
	Woodland opt. and harvesting courses	.595	.340	.845
	Woodland opt. and wildlife opt. courses	.666	.313	.549
	All three courses	-.151	.307	1.000
All three courses	Woodland opt. course	.843(*)	.245	.024
(mean: 4.67)	Harvesting course	.884(*)	.254	.020
	Wildlife opt. course	1.560(*)	.321	.000
	Woodland opt. and harvesting courses	.746	.328	.428
	Woodland opt. and wildlife opt. courses	.817	.299	.159
	Wildlife opt. and harvesting courses	.151	.307	1.000

* The mean difference is significant at the .05 level.

Conclusion

All in all, most of the comparisons we conducted in this section showed not much difference between VFLEP attendees and owners who attended other educational programs; rather, the difference was between the group of owners who did not attend any educational programs and the two groups of owners who did, and that these two groups showed values that were more oriented toward sustainable forest management (i.e., used technical assistance providers more, rated the of the usefulness of direct information from professionals higher, etc). Also, owners who never attended educational programs tended to perceive constraints to active forest management to be less limiting compared to owners who attended educational programs; this could be because either they did not actually manage their land, or did very little.

In light of these analyses, we can say that VLEP motivated owners, and proved to be more effective compared to both other educational programs, and no educational program in their adoption of some sustainable forestry practices, including woodland management practices, use of a written management plan, or use of technical assistance. These three groups of practices were all key features of the VFLEP shortcourses and adoption rates of all three were significantly improved by VFLEP attendance.

For the use of financial assistance the program did not prove to be as effective as some other type of educational programs though more effective than no educational program at all. For harvesting practices, the program was effective compared to the baseline (no educational program at all), but as effective as other types of educational programs; and finally, the VFLEP program did not have any impact on both the use of BMP practices and conservation easements. About the array of practices implemented, the VFLEP proved to be effective compared to the two other groups (other educational programs, and no program at all).

Within the group of owners who attended the VFLEP program, there was no difference between the seven categories when it comes to the adoption of the individual practices except for the use of a written management plan; in which only owners who attended all three shortcourses differed significantly from owners having attended only the Wildlife Options shortcourse, there were no differences between the other categories. Likewise, in terms of array of practices implemented, owners who attended all three shortcourses differed from owners who took any one of the shortcourses. And finally, related to the number of practices implemented, again,

owners who attended all three courses differed from those who attended only either the harvesting options shortcourse, or the wildlife options shortcourse.

This section of the study has several practical implications for Extension services that provide educational programs to NIPF owners in Virginia. Considering educational programs in general, we found that educational programs did not have any positive effect on both wildlife management practices and the use of conservation easement programs. Our findings implies and suggests more research are needed to find out why this happens, and eventually, that would imply some revisions in the approach used in future educational programs that will target those two particular practices. For the rest of the practices, we found that NIPF owners who attended educational programs were more likely adopters compared to those who did not, which suggests at least success of the educational programs provided to owners. However, the degree of success was not the same for the educational programs in terms of adoption of practices because in some cases (woodland management, the use of technical assistance, or the use of a written management plan), the VFLEP program translated into a higher likelihood of adoption, while for harvesting practices, other educational programs were a little bit better than VFLEP.

All of these suggest that stakeholders involved in designing and providing educational program would be more efficient if they collaborated and exchanged their ideas and experience, success and failure. Doing so would increase the success of any educational program, and use resources more efficiently (time, money, labor) by avoiding duplication of failures from prior programs.

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ARTICLE 3: COMMUNITY BASED NATURAL RESOURCE MANAGEMENT IN AFRICA

(Abstract)

For the last few decades, community-based natural resource management (CBNRM) programs have been promoted to reduce environmental degradation and to alleviate poverty. CBNRM focuses on increasing the power of local communities in the decision-making process regarding the management of their natural resources. Such a premise is very compelling, however, theory and practices are two very different things; in fact there is an important discrepancy between the concept and the reality in the field. Time constraints and the dynamic nature of the issue are two of the main causes of this discrepancy. Case studies from Tanzania, Gambia, Kenya and Botswana were analyzed to derive lessons learned and to make some recommendations for future CBNRM programs.

Key words: CBNRM, Africa, local community, natural resource management, Equity, empowerment, development, conservation.

Introduction

Community-Based Natural Resource Management (CBNRM) was promoted extensively in the last few decades as one of the best approaches for achieving biological conservation and improving the socio-economic status of local communities, especially in developing countries where rural people typically live in chronic poverty. CBNRM has a very convincing rationale, but relatively few examples of success exist in sustainability of natural resources, especially in an African society context. This paper will analyze CBNRM through four case studies in four African countries.

The first part of this paper is a review of the main concepts behind the rationale of CBNRM, and the various mechanisms that CBNRM uses for its dual goal of achieving both environmental and socio-economic sustainability. The second part of the paper reviews the impacts of CBNRM following field implementation. The third part of the paper deals with the lessons learned from the CBNRM cases in Africa with some recommendations proposed for a better approach and/or implementation of CBNRM in the practical world. All the data used in this paper (case studies) are from published literature on CBNRM in the various African countries.

Background

Before the mid 1980s, the prevailing paradigm for developing countries was a global and centralized type of natural resources management. This approach involved "asserting global primacy in the construction and prioritization of specific problems, and invoking particular rationalities for environmental management" (Schroeder, 1999). This approach was implemented around the world and was widespread in Africa, where, through many decades of colonization, the centralized structure was already in place and working well. Citizens and indigenous communities were not granted any property rights or access to natural resources; the same resources they had open access to before colonization. This situation remained unchanged during the years following the independence of most African countries; all public land remained the property of the central government, which, in most African countries, retained the colonial administrative structure. Anything that had to do with land, including management of natural resources was under the central government's responsibility. This period was also known as the period of "exclusionary conservation" (Berkes, 2004) during which local communities were excluded from conservation activities.

In 1980, the International Union for the Conservation of Nature (IUCN) published the World Conservation Strategy, which asserted that effective conservation is dependent on the development of rural communities (Stocking, 1992). This strategy was widely disseminated by the early 1990s, there was a 180-degree shift from a centralized approach to conservation. The management of natural resources became a stronger local priority, and was linked to the health, well-being and socio-economic condition of local citizens. Indeed, poor, hungry and desperate people are unlikely to afford and support conservation; it is a matter of logical priority. Conservation of natural resources becoming secondary when people are hungry and/or sick, the new trend had two dimensions of shifts, first involved the inclusion of humans into the ecosystem; and the second, a shift from an expert-based approach to a participatory conservation and management approach (Bradshaw and Bekoff, 2001). This new approach was then expected to be a more inclusive, people-oriented and community-based approach (Berkes, 2004). As a result, many governments and donor organizations have intensely engaged in designing environmental programs reflective of these shifts (Schroeder, 1999).

Goals and Conceptual Framework of Community-Based Natural Resources Management

The premise of CBNRM involves a convergence of environmental conservation and economic development. As such, CBNRM has been advanced as a way of improving the social and economic standards of local and rural people (Wells and Brandon. 1992). Tsing et al. (1999) view CBNRM as a way to reconcile goals of social justice (equity) and environmental sustainability. Little (1994) said that in CBNRM, whether it's developed in agriculture, water management, or forestry, centers on promoting the participation and enhancement of the power and decision-making role of local communities. Perhaps we can sum it all with what Stocking and Perkin (1991) said: "conservation is essential for development, and development is a prerequisite for successful conservation." Forsyth and Leach (1998) advanced that "there is increasing recognition that effective resource management must be linked with the issues of equitable access to natural resources, the promotion of sustainable livelihoods and the alleviation of poverty through participatory and empowering processes of development."

Another premise in CBNRM programs is that local populations have greater interest in the sustainable use of natural resources around them (Tsing et al. 1999) and are seen as more able to effectively manage natural resources through local or traditional practices.

These simple and logical premises are very appealing for both developers and environmentalists. CBNRM seemed then to be the panacea for finally overcoming environmental degradation, especially in poor countries and/or regions. Several mechanisms and characteristics go along with these premises: a large amount of literature deals with those mechanisms.

Many terms are used more or less interchangeably with CBNRM, such as social forestry, community forestry, community wildlife management, cooperative or co-management, participatory multipurpose community project and others. Though there are some differences between those terms, all of them have the same following characteristics:

- Active involvement of community members and local institutions in the management and conservation of natural resources through active and interactive participation.
- A devolvement of power and authority from central to more local institutions; this includes a shift from open access to community-controlled natural resource tenure. Empowerment, capacity building and sense of responsibility are emphasized here.

- A tendency to defend and legitimize local and/or indigenous resource and property rights, including giving ownership title back to the communities.

- Inclusion of traditional values and ecological knowledge in modern resource management. The assumption is that scientific and traditional knowledge are complementary and if combined, constitute a new pool of knowledge that can be used to tackle environment and development issues more efficiently.

Indeed, in any form of CBNRM, there is always emphasis on three areas: empowerment, participation, and property rights (Wells and Brandon, 1992); also, stress is put on achieving conservation goals through economic and social incentives, and by including traditional local knowledge and wisdom of local peoples accumulated over generations of intimate participation with the natural environment (Berkes, 1994).

The premises and the mechanisms intended to be used in the implementation of CBNRM are very logical and one would think there should not be any major difficulties in implementing them on the ground. The following part of the paper deals with the implementation of CBNRM on the ground in Africa.We chose four case studies from the literature in order to help us make our analysis of the topic:

- Case study 1 is on the Conservation-with-Development projects in the East Usambara Mountains of Tanzania (from Stocking and Perkin, 1992).

- The second case is on the German-Gambian Forestry Programme (GGFP) in Gambia (from Schroeder, 1999).

- Case study 3 is on the Kimana Community Wildlife Sanctuary (KCWS) in Kenya (from Kellert, 2000).

- The last case study is about a government-funded CBNRM program in Western Botswana (Twyman, 2001).

Community-Based Natural Resources Management in Practice: Approaches and Outcomes

The four case studies were selected because first, they represent a wide array of the livelihoods of most communities in Africa, second, they present different scales of the stakes (local, regional, national), and last, they were the cases for which we could get enough information on our evaluation criteria for analysis.

Case Study 1: Conservation with Development Projects in the East Usambara Mountains of Tanzania.

The East Usambara Mountains region is very rich in biological diversity, with a relatively high rate of fauna and flora endemicity. Because of this biological diversity, the International Union for the Conservation of Nature (IUCN) considered the region as one of the most important sites in the country to conserve. At the same time, the mountains are of direct economic importance at local, regional and national levels. An estimated 40,000 people depend on the forests for multiple products, including fuel wood, building poles, medicinal plants, etc. All of those local activities related to the use of forest products are informal but are vital to the everyday life of Usambara villagers. This ecosystem is also the main source of rivers, as well as drinking water for several towns downstream. And finally, at the national level, it supplies more than 80% of Tanzania's cardamom (major export spice), among other high-value export crops like cloves, cinnamon and/or tea.

Issues

There are two main issues: First, the production of cardamom and cloves are very degrading for the forest because the species need shade under an open canopy, thus, the primary closed canopy was opened for their production. The soil cannot sustain the production of those cash crops for more than eight years, after which the production declines significantly. It is then replaced almost systematically by sugar cane for about four years, followed by maize, and cassava until the land is no longer productive and is abandoned. The overall length of time from the closed canopy forest until the land is abandoned is about 17 years. Second, illegal logging is very common in the region, and since there is no control of the practice, it causes significant damage to the stand (Stocking and Perkin, 1992).

Approach

Realizing those main issues, a team of multidisciplinary experts developed a strategy to solve the problem and to conserve the mountains ecosystem while not depreciating the socio-economic goods and services that local people can get from it. They then developed the Conservation-With-Development program (CWD) with the following objectives:

- improve the living standards of the people in the area;
- protect the function of the forest, particularly the water catchments function;
- preserve the biological diversity and environmental values of the forests.

As a result, the multidisciplinary team of experts developed a strategy including agricultural improvements, such as making the production of cardamom more viable in incorporating it in agroforestry systems, coupled with soil conservation measures, promotion of alternatives to the cash crops (cloves and cardamom), and promotion of a range of village development activities including income-generating activities, local shops, sewing groups, road building and maintenance, along with forest protection measures.

Then the program implementers consulted the community regarding their willingness to participate in those activities for reaching the given objectives. As expected, local communities did not reject the offer.

Outcomes

Both positive and negative outcomes happened: on the one hand, activities like an improved supply for agricultural inputs (improved seeds, chemicals, tools, etc.), on-farm nurseries for cloves, adoption of fishponds, found positive success and adoption by the local villagers. Agricultural improvement activities also produced relatively positive outcomes. However, the alternatives to the production of cardamom were problematic, because the then current practice required relatively little labor and produced a high-value return compared to the alternatives that had higher labor/value ratio. Another factor that entered into the equation was that alternatives such as the agroforestry system proposed were uncertain at the time, agroforestry systems cannot produce tangible results before a decade or so; which, to the eyes of local people, is not the best alternative. Substituting cardamom for other high-value species also is not guaranteed to be a success.

The same thing happened with soil conservation activities which involved pegging the fields and repairing them when they get breached. Farmers were taught how to use the pegging

tools, and there was a fee assessed and paid to the pegging team. Four years after the beginning of the project, only 15% of the arable lands had been pegged and the reason that Stocking and Perkin (1992) advanced for the waning enthusiasm was that people were not convinced of the technique.

Forest conservation activities also faced big issues. For instance, village nurseries were of poor quality because villagers found they were difficult to manage. Limited labor requirements and/or knowledge were problems. The matter of ownership and land tenure are also big issues for activities like village afforestation and the establishment of village forest reserves, thus such activities did not produce positive outcomes. Another unintended result of the project was that the road improvements under the project helped illegal loggers to transport their products more easily and more frequently than before.

Case study 2: The Community Forestry Management Agreement

The Government of Gambia did not have any forestry service until the 1950s. For that reason, for a long period of time, there was a lack of knowledge about information crucial for devising any management plan. It was not until the 1980s, with the funding from the German government that the Gambian Forestry Service could conduct an inventory to estimate the national forest resources. Those inventories revealed that the forest resource base in Gambia, especially the national parks that constitute the last vegetative frontier towards the desert, were threatened by the poor forest management practices of rural people (Schroeder, 1999). The German-Gambian Forestry Program (GGFP) located their intervention sites in the "open access" forests that are in the vicinity of the parks. Open access lands were subject to a permitting process controlled by the government; open-access lands constitute 90% of the Gambian territory.

Despite that regulation, communities, frequently of pastoralists, regularly use those open access forests under rules and conditions set by the community members on forest products use, they call those forests "common property" (Freudenberger et al. 1997). Local farmers had only groundnuts as a cash crop, which they produce using swidden agriculture (shifting cultivation because it is the easiest and the least costly practice).

Issues

Further studies revealed that the main causes of degradation in this crucial part of the Gambian forests were due to bushfires and uncontrolled firewood extraction, and conversion of forest into agricultural land. The production of groundnuts competed directly with forest cover (Schindele and Thoma, 1995).

Approach

The German-Gambian Forestry Programme evaluated the situation and decided that it was more economical to protect and rehabilitate the then existing forests than to let them degrade and to start with afforestation of fast growing species (Schindele and Thoma, 1995). The least costly way to achieve the conservation of those forests, according to the GGFP, was to promote community-based natural forest management. Besides, the GGFP noticed four changes in rural livelihood systems that would favor the adoption of CBNRM: first, the market-price of groundnuts fell; second, the supply of key forest products, such as the raw materials used for roof beams, dropped substantially because of overexploitation; third, firewood prices rose

significantly, and fourth, harsh climatic conditions caused crop production shortfalls and reduction in water supply. The documents claim that the "successes" of natural resource management in forest parks were already demonstrated (Shroeder, 1999).

The GGFP's Community Forestry Management Agreement (CFMA) project used a performance-based system of rewards. Communities first had to demonstrate their eagerness and ability to manage their forests, and their fulfillment of the forestry department/GGFP requirements before the government would grant them concessions allowing them direct control.

Theoretically, the contract in question between the forestry service and the community should not be under a top-down approach, but should be the product of a thorough and often lengthy dialogue within the community, and then between the community and the technical services (USAID, 1992). The procedure followed for the CFMA was as follows: first, the department conducts a sensitization campaign at the district level, and then identifies areas considered high priority, and select communities in those areas as target communities. Most of the time, the selected communities functioned as buffer zones for the parks (Schroeder 1999). Second, the department conducts first rounds of contacts with the selected communities to 'assess' perceptions and attitudes of community members towards forest management. Third, the department conducts multiple meetings for assessing the pool of labor available, the delineation of the forests in question and the appointing of management committee members, and finally, the department conducts meetings between the management committee and the GGFP technicians; here as well, the management plan is supposed to generated by the community members, but in practice, it was often drafted by project personnel.

The final CFMA contract had over thirty conditions designed to regulate community forestry management including: (1) cooperation with the forest service anytime there is any event (workshops, inspection, etc..) related to the management of forests that the forest service requires; (2) compliance on updating the management plan every 10 years in exchange for the ownership; (3) agreement to undertake required activities in the forest, such as fire protection, in exchange for a regulated market of community forest products; and (4) that community members are liable for the cost of restoring the forest to its prior state wherever there is forest resource depletion (Schroeder 1999).

After those four points, the recipient community had to demonstrate their seriousness in good stewardship by complying with all the requirements for at least three years before they

were granted the concessions that provide them the rights of use and a direct control over the resources.

Outcome

According to the Forest Service/GGFP, the outcome is very positive since there were already 29 communities which were involved actively in CFMA contracts in only four years of implementation of the contracts.

Communities are actively involved in the activities they are required to do in exchange of granted regulated market of the goods they produce, the related economic benefits, and also the hope of getting sovereignty after the three years of "test" period. The Forest service/GGFP then thinks that communities willingly participate in the activities they are required to do because they realize that the benefits they gain largely offset the costs.

Case study 3: The Kimana Community Wildlife Sanctuary in Kenya

The Kimana Community Wildlife Sanctuary (KCWS) was created because of the recognition that wildlife conservation in the Kenyan region needed to include the community involvement to achieve its conservation goals (Kellert et al. 2000). Communities in the area are primarily Maasai. The traditional main activity of Maasai people is pastoralism, but nowadays, settled agriculture is also of great importance. Apart from those two subsistence activities in the region, wildlife tourism also contributes to the local economy. The Kenya Wildlife Service (KWS), which was an agency in charge of supporting financially and technically the KWCS development and conservation program.

Issue

In this case, the main issue was the incompatibility between agriculture and extensive pastoralism on one side and wildlife conservation on the other side.

Approach

The main objective in this case was to effectively manage and conserve the Kenyan wildlife, but since the KWS realized that they would not be able to reach that objective without including the indigenous people into the framework, they decided to incorporate those communities. The main goal remained the conservation of wildlife.

KWS provided financial support and technical expertise for the community after the latter had their elected management committee members, those committee members were the

representative of the community when it came to discussions with the KWS. The approach also emphasized devolvement of authority to local communities.

Outcome

The implementation of KWCS resulted in: First, a highly disproportionate distribution of benefits. Only a small minority of community members received monetary benefits from KWCS. Second, revenues were used by board members for personal purposes, not for the benefit of the whole community as originally intended. Third, as a direct consequence of those embezzlement allegations, intra-community conflicts increased compared to before the implementation of KWCS CBRNM. Another kind of conflict, though less often than intra-community conflicts are inter-community conflicts (between two different communities). Most of the time, the dispute was over resource delineation. A third type of conflict that might involve all groups is conflict due to inflated expectations, followed by frustration. Fourth, in terms of power, devolution resulted in power being concentrated in particular groups and sectors in the local communities. As a direct consequence, other minority powerless groups like women and minorities rarely saw any empowerment from the CBNRM used by the KWCS. This fact is what Agarwal (2001) called participatory exclusion. Finally, another unexpected outcome was the fact that decisions regarding extraction of forest products tended to be influenced more by external commercial interests mainly because of higher price proposed to the committee.

Case study 4: Community-Based Natural Resources Management in Botswana

Commercial livestock production is predominant in Botswana and expanded rapidly in the 1970s. As a result, the government revised its land assessment and zoning, leading to the creation of a new land category, called Wildlife Management Areas (WMA). In the WMAs, natural resources use and management were the primary activities. Another land category called Controlled Hunting Areas (CHAs) also was established. In the controlled hunting areas, hunting activities must be permitted by the government. The controlled hunting area are the subject of the CBNRM in this case study since on these lands, there is livestock grazing, subsistence agriculture, commercial safari hunting, and photographic safaris. Most of the controlled hunting areas fall within the WMAs.

The local population is not a homogeneous society, but is a mixed society with different ethnic groups sharing the same land, including the Botswana, Bakgalagadi and the minority Basarwa. Each of these groups had a different history of resource relations in the area (Twyman,

2000). The Basarwa people were the first settlers in the area, they depended on the wildlife; then came the Batswana and the Bakgalagadi, who were mainly pastoralists. As the pastoralists developed their economic activities (more cattle), their control over wildlife also increased at the expense of the subsistence tribe Basarwa. Later came Europeans and south-Africans that were looking for safari trophies. The Batswana were most likely to gain the most benefits from trading with those newcomers.

Issue

The main issue here is the change in the environment that followed the intensification of the cattle grazing. The water table was lowered, which became a problem for both the wildlife and the local people, who then became dependent on white farmers who could have access to groundwater. The vegetation change due to cattle grazing also affected the Basarwa people who relied on many wild species for food. The hunting and gathering economy of the Basarwa was then no longer viable. They had to change their livelihood and they began to work for white farmers in order to subsist. As a measure to help maintain the remaining wildlife and improve the Basarwas' economic situation, the regional Department of Wildlife and National Parks (DWNP) decided to introduce CBNRM into the community. A main component of the project was to grant access to tourists on the CHAs and permit them to hunt on these lands but in return, the safari companies would pay the local communities for using their land and hunting their animals. The issue is that the Basarwa people are concerned with the sustainability of the animals and even changed their livelihood because of that, and now, the DWNP proposed to bring strangers to hunt the few remaining animals.

Approach

The approach was a replication of what already happened in other parts of the country, involving community consultations by DWNP personnel through public meetings, workshops, committee elections and field trips. The messages used in those meetings emphasized empowerment and participation but there were strong undertones of subordination and manipulation. Indeed, an element of choice was implied in the projects being presented to the communities, but "it became clear that only certain avenues were supported by the government and these were the ones to be likely successful" (Twyman, 2000). This kind of approach is what Michener (1998) called "planner-centered" form of participation: suggesting participation was desirable because involvement of local people would lead to the success of the project, rather than participation being a means of empowerment in itself.

In brief, the type of participation that the DWNP provided the community was only nominal, primarily informing people about what could happen, rather than letting them take actions themselves.

Outcome

The community was considered the "program receivers," which is not very different from other projects the community experienced in the past and from which they did not get anything tangible. The community's perception (especially the Basarwa) of the new project was ambiguous: on the one hand, they had a bad experience with project failures and natural resource dispossession, but on the other hand, they saw the project as a new means to gain access to new resources. Indeed, in this region, Twyman (2000) stated "…in the past, they have received no remuneration or even feedback for the labor and time they had to put into projects." For those reasons, local people were skeptical of the DWNP CBNRM project. Taylor (1998) found that "though there was a wide range of understanding about projects, even when this is high, distrust of government initiatives makes people highly skeptical about projects."

Analysis

The case studies presented here demonstrate that the implementation of CBNRM is not always as easy as it is supposed to be. CBNRM is very different from the conventional, centralized management of natural resources, only based on a linear cause-effect relationship and a very mechanistic view of nature, a view that aimed to make nature more productive, more predictable and more controllable (Berkes, 2004). This reductionist concept of nature led to the failure of former global environmental policies. CBNRM is much more difficult to implement than the linear approach because it takes into account the variability of nature, especially since humans are included into the equation.

Since the four case studies are very different from each other, we use the following criteria to analyze them in a more uniform way; some of them assessed directly the mechanisms implicit in CBNRM:

Approach: It can be either planner-centered: driven by the planners' objectives, or people-centered: driven by communities' objectives**.**

Participation: The level of participation that every member of the community is offered (Table 122).

Procedural equity: Is related to the equal chance given to each member of the community to improve their quality of life from the CBRNM project.

Distributive equity: Is related to the balanced share of the benefits obtained from the CBRNM activities.

Property rights: Is related to the ownership status of the natural resources in question.

Power devolution: Is related to the change from a centralized decision-making process to a more locally (community) based system of decision-making one.

Knowledge: Is related to the two-way flow of knowledge between experts and local communities.

Local institution: Is related to the local community's capability to have its own institutional structure, which will be needed for the sustainability of natural resources management.

Trust: related to whether or not the local community in question trusts their government or project managers?

Stake: related to the scale level and the importance of the stake (local, regional, national). Table 113 provides our assessment of the four types of CBNRM projects:

Table 113. Summary of the four cases of CBNRM projects.

	Tanzania	Gambia	Kenya	Botswana
Approach	Planner-centered	Planner-centered	Planner-centered	Planner-centered
Participation	Activity-specific	Activity-specific	Interactive (elites)	Activity-specific
Power devolution	No	No	To the elites	Not effective
Procedural equity	No (Imposed)	No (Imposed)	No	No (indirectly imposed)
Distributive equity	Yes	Yes	No (favored elites)	Not mentioned
Property rights	No ownership	Yes (after 3yr test)	No	No
Knowledge	One way flow	One way flow	None	One way
Local institution	Not mentioned	Yes	Yes	Not mentioned
Trust in the techniques	No	Not sure	n/a	Not mentioned
Trust in the government	Neutral	Yes	Not mentioned	No
Stake	Local, regional, national	Local, regional, national	mainly local	mainly local
Results	Slightly positive	Positive so far	Status quo	Negative
Main problem	Economic stake too important	Real reason behind current motivation	- Extraction influenced by external actors - Inflated expectations	Lack of trust in the government

None of the four cases were people-centered; all of them were planner-centered, meaning that there was no consultation of the community prior to the definition of the project's objectives. The direct consequence of this, especially if the objectives stated and the activities proposed do not conform to what the community wants, is the project is unlikely to succeed (success is related to sustainability of the project). We can see clearly from these case-studies that when the approach is planner-centered and when there is no substantial benefit gained from the project, the project in question is unlikely to become sustainable. When a planner-centered approach is combined with economic incentives (case of Tanzania), then communities might not buy the main objective of the project, but they are just interested in the economic profits, which appears to be a good sign right now, but what happens once the technical expertise and financial assistance come to an end? The other case where we can see some positive outcomes is the Gambian case, it is the most restrictive form of CBNRM among the four presented, and it seems to be the one presenting the most hopeful prospects. It seems that this project is very prosperous, but what we do not know is the real motivation behind this willingness to participate in the project: it is highly probable that people are motivated by the possibility of land ownership after

good management only three years. The big question is: what is going to happen after they actually get the ownership of their resource?

Property rights (including land ownership) is also another mechanism promoted by CBNRM, but we could see from these four cases that only one actually implemented it in the field. This illustrates again the discrepancy between the conceptual framework in CBNRM and its implementation. Actually in the three other cases that do not present any possibility of ownership, communities are granted user rights, but it is not always enough to motivate people to buy into projects that do not address their needs.

The type of participation is very critical in CBNRM projects. Table 114 shows the typology of participation in a CBRNM project, developed by Agarwal (2001).

Table 114. Typology of participation

Form/level of participation	Characteristic features
Nominal participation	Membership in the group
Passive participation	Being informed with decisions (post facto), or attending meetings and listening in on decision-making, without speaking up.
Consultative participation	Being asked an opinion in specific matters, without guarantee of influencing decisions
Activity-specific participation	Being asked to (or volunteering to) undertake specific tasks
Active participation	Expressing opinions, whether or not solicited, or taking initiatives of other sorts
Interactive (empowering) participation	Having voice and influence in the group's decisions

The discourses of accountability and motivation by the different stakeholders are critically linked to the type of participation perceived in operation. When people feel like they are not empowered at all, but only reduced to the role to always comply, there is not going to be any motivation for them to remain in that position, thus, the best alternative is for them to quit the project (cases in the abandoned activities in our CFMA case study).

The third mechanism that community forestry is supposed to use is the devolvement of power and authority (empowerment). This point is very much related to the level of participation and the two-way flow of knowledge between community and experts. Empowerment consists of providing local communities the tools they need to acquire more power and improve their stand against petty actors. Of the four cases reviewed, no project provided the full tools to permit the community to acquire their full range of empowerment, i.e., active participation, inclusion of the community starting from the identification of the problems and the formulation of the objectives,

and providing them the possibility to learn from and to share their knowledge with the experts. The lack of empowerment resulted in the fact that local people found it difficult to voice their concerns about environment and sustainability (given the power relations) in the planner-centered participation process. They were only given a passive participation role, or at most, consultative participation.

Another point, still related to one of the principal mechanisms governing CBNRM is the two-way flow of knowledge. One of the main objectives of CBNRM is the valuation of local knowledge about the environment and the management of natural resources, and at the same time, transferring ecological and scientific knowledge to the community. In the case of KWCS, none of those were tangibles (Kellert et al. 2000). In all of our cases, the transfer of knowledge was only in one way: from the experts to the community. In theory, given the "wicked" nature of the problem, CBRNM projects should use the largest possible array of knowledge in order to tackle the problems; but in practice, the tendency has been to educate and bring communities in compliance with the scientific advice of the experts. Traditional community knowledge and scientific knowledge are supposed to be complementary and not mutually exclusive. Adopting approaches such as those we had here restricts the potential of the problem solving that could have been attained in using both types of knowledge at the same time: for example, in the Kenyan case, the traditional knowledge of the Maasai about grazing livestock and wildlife movements was not taken into account in the project, resulting in a loss of valuable information for the sustainability of the project. The use of community knowledge is one way for the community to have a say in the decision making and would have increased communities' adoption of the project.

Another major point is the matter of trust. Trust is a fundamental criterion in the success or failure of a project. We can take two of the cases here: the first is the Gambian case, in which the community trusts the government that they are actually going to be provided ownership of the resources, and the other case is the Botswana case, in which the communities already have a negative attitude toward any government-driven project. We can clearly see that in both cases, the project was planner-driven, and that the project's objectives were not quite the same as the community's. The case where there was trust presented more positive results than the other one.

Last but not least important point related to the core of CBNRM is equity. Equity has two components: procedural and distributive equity (Brown, 1986). Procedural equity is about giving

the community /community members the same chance and tools to attain their goals through the given project. The process is the most important, it does not matter even if the distribution of outcomes is not equal as long as everybody is treated equally in the process (i.e., everybody is given the same chance of undertaking activities, then the ones who worked on difficult or time consuming activities get more outcome than those who worked on easy tasks). On the other hand, distributive equity refers to the distribution of the outcomes in equal share for each member of the community, disregarding the amount of investment of any kind (labor, financial, time, etc.). In all of our cases, procedural equity is lacking because all of the tasks were already more or less imposed by the planners. However, we have two cases that present distributive equity and two others that do not. It is very delicate to favor one or the other of those two kinds of equity, logically, and based on the fact stated earlier that a community is not homogeneous, we would tend to say that procedural equity should be better than distributive equity because it would be unfair to share the benefits equally when the amount of investment was not equal. On the other hand, if we favor procedural equity, thus taking distributive equity off the table, there is a big risk that all the benefits will just go into the hands of few individuals in the community, like in the Kenyan case.

Other points we can derive from these cases, include the fact that there is no standard CBNRM recipe that can fit all communities (Folke et al. 2002). There was a marked lack of recognition of the diversity of local resource use and resource users, and of the complexity of livelihood strategies based on natural resources in local environments which are highly variable Twyman (2000). This variability was either across communities or temporally within the same community. Though most of the communities are using agriculture and livestock as main source of livelihood, there is a difference across communities. Indeed, each community has its own traditions, culture, livelihood, social structure and more. We can see for instance the big difference from the two communities in the Tanzanian case, whose main livelihood was the production of high-value cash crops such as cardamom. This situation is much different from the communities in the Botswana case in which community livelihood was based on hunting and gathering, followed by subsistence agriculture, livestock production and labor on white-owned farm).

We can also mention the other dimension that uncertainty brought into the field of natural resources management. In the case studies we presented here, we can cite the uncertainty of the

eventual success of the alternatives to the production of cardamom, the uncertainty of whether the CFMA approach is going to produce a sustainable outcome, and the uncertainty about the real willingness of the local people to get involved into the project in Botswana. Moreover, as Carlsson (2000) found, the community itself is not a cohesive entity; it is elusive, changing, having different interests, and social structure. This non-cohesiveness is present either in space or in time: in our case studies we can cite the Batswana and Basarwa, nomadic Maasai and settled farmers, etc. For this reason, researchers like Ostrom (1990) recommend focusing more on local institutions and not on communities. She argued that institutions are humanly devised constraints that structure human interactions, made up of formal constraints (rules, laws), informal constraints (norms of behavior, self-imposed codes of conduct, etc.). Berkes and Folke (1998) and Berkes (2003) worked on the dynamics of those institutions, their renewal, their learning and adaptation, and ability to deal with change. The idea here is to minimize the uncertainty in the CBNRM, one way to do that is to have at least a stable structure to deal with, such as the institutions developed by the committee members. A consequence of those uncertainties is that CBRNM projects face what Ludwig (2001) defines as wicked problems, which are problems that are not static, cannot have any definitive formulation, and cannot be separated from issues of values, equity and social justice.

All of this leads us up to the conclusion that better management of natural resources requires complex adaptive systems in which human societies are necessarily an integral part. Kates et al. (2001) said that there is no one size fits all solution in sustainability science; it requires place-based models because understanding the dynamic interaction between nature and society. Tsing et al. (1999) also argued that generalized models of CBNRM cannot be inserted into specific contexts without attention to the history and politics of implementation, as well as the differing characteristics of local environments.

It is obvious from the case studies presented here that the theoretical framework and the practice of CBNRM present a discrepancy in almost every aspect of the mechanisms that CBNRM is supposed to implement. One of the reasons that could explain that fact is time constraint: most of African Forestry Services do not have the means to fund their own activities, they do not have sufficient number of personnel, nor material means. Also, most of them rely on foreign funding to function (case of Gambia). Donors also have their own objectives that they are

seeking and require those governmental institutions to attain. Most of the time, the primary objective is conservation, and secondarily economic development of the community. Also, the objectives in question, or at least tangible progress, have to be attained in a relatively short term (rarely exceeding five years). As a consequence, government personnel and project workers cannot afford the time for lengthy discussions and arrangements with local communities before setting up the project and beginning to work. For that reason, all activities, or alternatives that could not be assessed within the timeframe were not given priority, whether they could contribute to a more sustainable use of the resources or not. Stocking and Perkin (1992) acknowledged that components that require changes in thinking and behavior receive relatively less attention, despite their crucial importance to project sustainability unless they embrace people's core values.

In the Tanzanian case, the "hit or miss" approach (i.e., trying numerous activities) was used. Perhaps it would be better to concentrate on a smaller number of clearly defined activities that would be much easier to manage. Additionally, the evaluation of the viability and cost-benefit at the household level of introduced techniques should be emphasized.

In the Gambian case, participation in the CFMA contracts involved costly trade-offs, for a given community to be granted the sovereignty to manage their forests, its members had to perform a large array of required tasks with their own means (or just marginal help from the forest service); the result is a substantial cost-saving for the Forestry Service/GGFP. In other words, the Forestry Service/GGFP imposed the form of participation, structure and institution that community members had to have, CFMA contracts defined management criteria so tightly that very little initiative remained at the local level; and communities were forced to assume certain costs of management. As mentioned earlier, the danger here is about what is going to happen after the community gets the ownership of their resource.

In the Kenyan case, there must have been an important communication flaw between the KWS and the local communities and/or between the management committee and simple committee members if most residents ended up thinking that KWCS was a means for exclusively pursuing social economic development, leading to the reverse effect of what was expected, that is, an increased pressure to exploit natural resources through fueling expectations and facilitating access to the very resources. Thus, communication is also a very important tool to consider in the implementation of a CBNRM project. Indeed, different stakeholders may perceive the same fact

differently, so there is nothing else than good communication to bring them all on the same page to avoid the issue of inflated expectation.

Understanding natural resources management and rural development involves both serious empirical work at the local level and a wider framework of analysis capable of dealing with the complexities of administrative practices and ways in which policies and programs are "internalized" by the various people connected with them. (Arce et al.1994).

The CBNRM in Botswana aimed to be more inclusive rather than exclusive, but the power relations were not even, thus, local people were reluctant to refute government help for fear of losing the benefits that they may get, yet were powerless to actually change the way in which that help was directed to suit their needs more (Twyman, 2000). Community empowerment is a sine qua none condition for the success (sustainability) of any natural resource management project. And for effective participation, people need to be involved from the start of projects when priorities and objectives are identified and set (and at times and in ways suitable to different members of the community or group). It is only then that projects can be locally relevant as well as locally owned, and later, be sustainable.

Conclusion

This section of the study was an attempt to analyze the theoretical foundation, as well as the implementation of CBNRM in Africa. It showed that a discrepancy exists between the theories and the practice of CBNRM. This discrepancy was caused mainly by: first a restricted time frame in the field of natural resources management (five years or less); and second, the variability in nature and in community; no community is exactly identical to another, so is the case of resources; thus, every CBNRM program has to be tailored to the reality of the community and its environment. Since most CBNRM projects have a dual objective, depending on how convergent the project's primary objective and the local community's objective are, the use of CBNRM can facilitate or constrain the sustainability of natural resources (Becker and Ostrom, 1995). All those require time, which we think is the biggest issue here; as Berkes (2002) emphasized by saying that institution building at the community level may take up to ten years for simple, local level, somewhat autonomous institutions. Though not many positive results are known so far in Africa, we think CBNRM can greatly help alleviate poverty and solve conservation issues at the same time. Also, we could see throughout the paper, in reality, the process used for implementing the CBNRMs effectively reinforced central control over "community resources" (Schroeder, 1999), illustrated by the Tanzanian and the Gambian cases mainly. In brief, we think that the question we should ask is not whether CBNRM programs work or not, instead, we should ask: is the project concerned with empowerment or compliance, participation or dictation, and is it looking for sustainability or short term-results?

This section about CBNRM was included in this study to contrast the two socio-economic, cultural, and ecological contexts of sustainable forest management (SFM) in the US, and in Africa. In both contexts, the ultimate goal remained the same: "ensuring that the ecosystem provides its fair share of values, neither unfairly exploiting, nor depriving themselves of certain values to the detriment or benefit of people in another place or time" (Oliver, 2003; p:9). On the one hand, several key factors, such as land tenure (private/public), equity (distributive and procedural), participation, accessibility for technical or financial assistance, and power devolution were totally different in both worlds. Nevertheless, we could identify several

points in common for both the US and Africa for ensuring the adoption of SFM practices: the uniqueness of each case; trust, notion of outside control, uncertainty, and social pressure.

The first point we found in this study was that for the reaching the ultimate objective of SFM, there is no one-size-fits-all approach that could be applied to all NIPF owners in the US, or all local communities in Africa. Approaches toward SFM have to be tailored to the individual/ community' s objectives, values, culture, resources, etc in order to be successful.

We found in the first section of the study that trust was a factor on which depend an individual's motivation to process the information he/she gets from the source (ELM theory). Without trusting the information provider, an NIPF owner would not be tempted to adopt a given behavior; the same thing happened in the CBNRM system in the Botswana case; local communities did not trust the government and the result was a non-adoption of the suggested SFM practices.

Related to the previous point is the notion of outside control: we found during our study about NIPF in Virginia that one of deterrent reasons for NIPF owners to adopt practices such as conservation easements was the fact that doing so was perceived as an outside control on their land. It would prevent their flexibility in doing what they want to on their own land for several years. Likewise, the planner-centered approach used in the CBNRM cases was most of the times considered invasive by the local communities but since it is most of the times imposed by the government officials, they do not have any choice but comply. Which might become a very big issue in the future because the ultimate goal of SFM is to have responsible people, not just people complying with regulations (implicit or explicit); behavior adopted just for compliance with regulations will ultimately not last.

Uncertainty was what we described as "perceived behavioral control" in the NIPF in Virginia section of the study; we found that too much uncertainty would deter a NIPF owner from adopting a behavior. A parallel fact applies to the CBNRM communities because more sustainable alternative systems (to replace their destructive agricultural practice) such as agroforestry are not expected to provide tangible positive outcomes before at least a decade, if at all. This was also a deterrent factor for local communities in Africa.

Social pressure was mentioned in the NIPF owners' study to be an important factor for an individual's decision making; in the CBNRM study, social pressure was even more important because not a single individual could do anything that contradicts the community's values and

norms and goals. Thus, any SFM practice suggestion has to take into account the community's values and norms.

Although this study provided new insights into a better understanding of NIPF owners and communities in Africa behavior toward SFM practices, it has several limitations: one of the most important limitations consists of not considering the non-response bias; our however, demographics characteristics of respondents from the last mailing wave were not too different from that of the whole sample (Appendix Q); assuming that NIPF owners who replied to that last wave of mailings are similar to those who did not respond, we can say that non-response bias is not very important. Another limitation of the study was the fact of considering all practices as equally important while some practices are actually more important than others. Finally, it is important to mention that not all CBNRM programs in Africa were failures, the four cases considered in this study only illustrate easier the discrepancy between how well some programs can be on paper but it might be more complicated to implement it on the field.

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APPENDICES

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August 29th 2006.

Appendix A: Advance letter used for the pretest of the questionnaire

Dear Mr. X,

You have been randomly selected from the Virginia Forest Landowner Update subscribers' list to take part in a survey designed to help us increase understanding of the main motivations (and/or constraints) for non-industrial private forest landowner to practice forestry on their land.

Your participation in the survey is very important to us. So when you receive the questionnaire in the mail (within one week or so) from Virginia Tech, please fill it out and return it as soon as possible.

This research is sponsored by the Department of Forestry at Virginia Tech and the Virginia Forest Landowner Education program. The results of this study will be used to help future educational programs to address the needs of non-industrial private forest landowners in Virginia, such as yourself to better manage their forest land.

Thank you for your help.

Sincerely,

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September 05, 2006

Appendix B: Cover letter for pretest of questionnaire

Dear Virginia Forest Landowner,

Here at Virginia Tech, we have been working with Virginia forest landowners like you for many years. Currently we are engaged in a study to determine how and why folks like you choose to practice forestry (or not practice) on your land. We are especially interested in the role of educational programs offered through the Cooperative Extension Service, and special assistance provided by technical foresters.

We have randomly selected your name from our Extension Service list of forest landowners in southwest Virginia. Would you be willing to participate in our study?

Enclosed is a copy of the questionnaire that includes questions about:

- Demographics,
- Information concerning your forest land,
- Your objectives for owning forest land,
- The type of management and practices used on your forest lands,
- The relative importance of the technical, financial and educational components in choosing the practices to use on forest lands,
- The issues and constraints in forest management,

Please take the time to complete the questionnaire, fold it in half, and return it in the enclosed self-addressed stamped envelope. It would be very helpful to have your completed questionnaire returned to us by September 29, 2006. Your responses are confidential. No names or individual information will be released to anybody.

Feel free to use the last page of the questionnaire to provide comments and/or suggestions to improve the survey.

Thank you so much for your help,

Sincerely yours,

James E. Johnson
Associate Dean – Outreach
Department of Forestry

Mami Rasamoelina
Graduate Research Assistant,
Department of Forestry

Appendix C: Pretest Results

1- Do you own forest land in Virginia?
IF NO, PLEASE SKIP THE REST OF THE QUESTIONNAIRE AND SEND IT BACK TO US.
IF YES, PLEASE GO TO QUESTION 2

☐ Yes
☐ No

35 res: Yes: 19 No: 16

2- How many acres of forest land do you own in the state of Virginia?
IF YOU OWN MORE THAN ONE TRACT OF FOREST LAND, PLEASE PROVIDE THE TOTAL ACREAGE OF ALL YOUR TRACTS COMBINED.

I own a total of _____ acres of forest land.

19 res: 5-700 acres (avg 135)

3- What is the yearly amount of money that you invest on all your forest land?

I invest $_____ per year on my forest land.

12 res: $0-500 (avg $125)

4- In what year did you first acquire fore

Year: _____

18 res: 2- 44 yrs (avg 25 years)

5- For the purpose of this survey, a farm is a place where, in most years, income is earned from the sale of crops (other than forest products) or animals. Do you own a farm that is within one mile of your forest land?

☐ Yes
☐ No

18 res: Yes: 11 No: 7

6- Is your home (primary residence) within one mile of any of your forest lands?

☐ Yes
☐ No

19 res: Yes: 14 No: 5

7- How many months per year do you (or your family members) spend on activities related to the care of your forest land?

_____ months per year.

17 res: 0-12 mths (Avg 1.5 month)

8- During those months, how many hours per week do you (or your family members) spend on activities related to the care of your forest land?

_____ hours per week.

15 res: 0-20 hrs (Avg 3.5 hours)

9- How many people in your household take part in those activities?

_____ people.

18 res: 0-5 ppl (Avg 1.5)

10- People own forest land for many reasons. How important are the following as reasons for why you own forest land in Virginia? MARK ONE BOX FOR EACH ITEM

	Very Imp	Somewhat important	Somewhat Unimportant	Very Unimp
- To enjoy beauty or scenery	15	3	0	0
- To protect nature and its diverse animal and vegetal species	12	5	1	1
- For land investment	2	7	4	3
- Part of my home	10	3	1	3
- Part of my vacation home	1	0	1	10
- Part of my farm	9	4	2	3
- For privacy	11	4	1	1
- To pass land on to my children or other heirs	12	3	1	3
- For cultivation/collection of non timber forest products	3	5	2	8
For production of energy (firewood, biofuel)	4	8	2	4
For production of sawlogs, pulpwood or other timber products.	0	9	2	4
For hunting or fishing	4	7	1	6
- For recreation other than fishing and hunting	9	5	1	2
- As retirement fund	1	2	6	6
- To supplement yearly income	0	1	6	8
- Other: please specify _____				

11- Have you ever leased or collected money (other than from logging) for allowing people to use your forest land?

☐ Yes
☐ No

19 res: Yes: 0 No: 19

12- Since January 2001, how often have you participated in any educational program (short courses, field tours, seminars, conferences, etc.) related to the management of your forest land? CHECK ONE

☐ More than 10 times
☐ six to 10 times
☐ twice to five times
☐ Once
☐ Never

19 res:
Never : 13
Once: 4
Twice to 5 times: 2

13- Since 1997, have any of the following activities occurred on any of the forest land you own in Virginia? CHECK ALL THAT APPLY

- ☐ Prepared land for new trees (site preparation) 4
- ☐ Planted trees 6
- ☐ Reduced fire hazard 3
- ☐ Applied herbicides, pesticides, or fertilizers 6
- ☐ Built or performed maintenance on roads or trails 8
- ☐ Wildlife habitat/fisheries improvement projects 8
- ☐ Posted land to restrict public access 9
- ☐ Conducted a boundary line survey 3
- ☐ Put up gates 7
- ☐ None of the above 2

14- Professional help is any kind of help received from an expert in one specific field. Since 1997, have you used any professional help for managing any of your forest land?

☐ Yes
☐ No **19 res: Yes: 8 No: 11**

IF YES, GO TO THE NEXT QUESTION, IF NO, GO TO QUESTION 17

15- What type of professional help did you receive ? CHECK ALL THAT APPLY

- ☐ Woodland management plan 6
- ☐ Wildlife management plan 1
- ☐ Timber sales and harvesting planning (timber marketing, sales assistance, etc.) 1
- ☐ Forest stand management (silviculture techniques) 3
- ☐ Reforestation and planting 1
- ☐ Recreation and aesthetic planning (hunting leases, recreation and conservation easements, etc.) 1
- ☐ Taxes and estate planning 0
- ☐ Cost share program assistance 1
- ☐ Other (please specify) 0

16- If you responded "Yes" to question 14, from whom did you receive professional help? CHECK ALL THAT APPLY

- ☐ Private consulting forester 5
- ☐ Private consulting wildlife specialist 0
- ☐ Virginia Department Of Forestry (forester) 4
- ☐ Extension agent 1
- ☐ Virginia Department of Game and Inland Fisheries (biologist) 0
- ☐ Forest industry landowner assistance program 0
- ☐ Certified public accountant 0
- ☐ Lawyer 0
- ☐ Logging firm or timber buyer 1
- ☐ Other: (please specify) 0

17- Related to any of your tracts of forest land, which of the following applies to you? CHECK ONE

- ☐ I have a written management plan that I am following (implementing). 5
- ☐ I have a written management plan that I don't use 4
- ☐ I am currently developing a written management plan. 0
- ☐ I don't have a plan but I am interested in having one. 2
- ☐ I don't have a written management plan and I am not interested in having one. 7

18- If you do not have a written management plan, could you give a reason? CHECK ALL THAT APPLY

- ☐ I never thought about it 2
- ☐ It is too expensive 0
- ☐ It is not necessary for managing my forest land 4
- ☐ I don't own enough land to worry about managing it 3
- ☐ I do not have the knowledge to develop it 0
- ☐ I will have one, but it is not my priority yet 1
- ☐ I don't spend enough time on my land to keep up with managing it 1
- ☐ Other (please specify) 0

19- Have trees ever been harvested from any of your forest land, for other purposes than use for your personal firewood ?

☐ Yes **19 res: Yes: 9 No: 10**
☐ No

IF YES, GO TO THE NEXT QUESTION, IF NO, GO TO QUESTION 25

20- Why were trees harvested or removed? CHECK ALL THAT APPLY

- ☐ To achieve objectives in my management plan 1
- ☐ Trees were mature 6
- ☐ To clear land for conversion to another use 0
- ☐ Needed the money 2
- ☐ Price was right 2
- ☐ To improve hunting opportunities 0
- ☐ To improve scenic and recreational opportunities 0
- ☐ To remove trees damaged by natural catastrophe 6
- ☐ To improve quality of remaining trees 5
- ☐ To allow for creation of a new, young forest 4
- ☐ Other (please specify) 1

21- During the most recent harvest, did you (or a professional forester) mark the trees prior to harvest?

☐ Yes
☐ No

8 res: Yes: 4 No: 4

22- Prior to the most recent harvest, did you (or a professional forester) estimate the volume of timber products you were going to sell?

☐ Yes
☐ No

8 res: Yes: 2 No: 6

23- During the most recent harvest, did you have a written contract for timber selling?

☐ Yes
☐ No

8 res: Yes: 2 No: 6

24- Which of the following types of harvesting practices have you ever used when harvesting your forest land in Virginia? CHECK ALL THAT APPLY

☐ Remove all of the trees in a large area (more than 2 acres) at one time. **2**
☐ Harvesting small group of trees where the groups are 2 acres or less. **1**
☐ Most of the trees in an area are harvested but a few selected by a forester are left to provide a seed source **0**
☐ Individual trees, very old or sick trees mainly of various sizes, dispersed throughout the forest, are selected for harvest. **2**
☐ All trees of at least a certain diameter are removed (please specify:_____ inches diameter) **1**
☐ Logger chooses which trees to cut **3**

25- Are you aware of Virginia Best Management Practices for foresters?

☐ Yes
☐ No

17 res: Yes: 5 No: 12

IF YES, GO TO THE NEXT QUESTION, IF NO, GO TO QUESTION 27

26- Do you use those practices on your forest land?

☐ Yes
☐ No

5 res: Yes: 4 No: 1

27- Cost-share programs provide landowners with money to help plant trees or manage their forest land. Since 1997, have you received any support for using a cost-share program to help manage your forest?

☐ Yes
☐ No

18 res: Yes: 2 No: 16

IF YES, GO TO THE NEXT QUESTION, IF NO, SKIP TO QUESTION 30.

28- Since 1997, what is the approximate yearly amount of support that you received for using a state or federal sponsored cost-share program to help manage your forest land?

1 res: $5000 once (not per year)

$ _____ per year

29- Which of the following cost-share programs have you ever used for any of your forest land? CHECK ALL THAT APPLY

☐ Reforestation of timberlands (RT) **1**
☐ Environmental quality incentives program (EQIP) **0**
☐ Forest land enhancement program (FLEP) **0**
☐ Virginia agricultural BMP cost share program **0**
☐ Virginia BMP tax credit program **0**
☐ Nutrient management equipment tax credit program **0**
☐ Conservation reserve program (CRP) **0**
☐ Conservation reserve enhancement program (CREP) **1**
☐ Forestry incentives program (FIP) **0**
☐ Wildlife habitat incentives program (WHIP) **0**
☐ Partners for fish and wildlife (PFW) **0**
☐ Wetlands reserve program (WRP) **0**

30- Conservation easements are legally binding agreements that sometimes result in payments to owners) that restrict land from being used for certain, designated purposes, such as development. Is there a conservation easement on any of the forest land that you o

18 res: Yes: 4 No: 14

☐ Yes
☐ No

IF YES, GO TO THE NEXT QUESTION; IF NO, GO TO QUESTION 32.

31- What types of activities are restricted? CHECK ALL THAT APPLY

☐ Conversion of forest land to another land use **0**
☐ Splitting of forest land into smaller land holdings **4**
☐ Harvesting of trees **0**
☐ Building houses or other structures **4**
☐ Building roads **3**
☐ Other (please specify) _____ **0**

32- Have you used any of the following practices in managing any of your forest land? CHECK ALL THAT APPLY

☐ Thinning trees	4
☐ Pruning trees	4
☐ Prescribed burning	1
☐ Use of fire lanes	0
☐ Herbicide application	5
☐ Planting trees	6
☐ Fertilizing trees	1
☐ Controlling exotic species	5
☐ Protecting special places, such as waterfalls, pools and springs	2
☐ Protecting cultural features like old cemeteries	2
☐ Maintain roads and culverts	8
☐ Maintain painted boundary lines	1
☐ Other (please specify)	0

33- Do you use any of your forest land for wildlife management purposes?

☐ Yes
☐ No

18 res: Yes: 5 No: 13

IF YES, GO TO THE NEXT QUESTION; IF NO, GO TO QUESTION 35.

34- For managing forest land to enhance wildlife habitat management, which of the following practices have you ever used on any of your forest land? CHECK ALL THAT APPLY

☐ Management of certain tree species (those providing food for wildlife) over others.	0
☐ Protection of habitat by creating fire lines	0
☐ Lowering the amount of fuel by using prescribed burning	0
☐ Controlling invasive species (plant as well as animal)	1
☐ Placing nesting boxes	2
☐ Placing food plots	2
☐ Installing ponds or water holes	1
☐ Protecting special places like springs and pools	2
☐ Other: (please specify)	

35- Since 1997, have you received any information and/or advice about managing your forest land?

☐ Yes
☐ No

19 res: Yes: 10 No: 9

IF YES, GO TO THE NEXT QUESTION; IF NO, GO TO QUESTION 37

36- If yes, check all sources of information you used so far from the following list

☐ Virginia department of forestry	5
☐ Extension forester or other university employee	3
☐ Private consultant, such as a forester or a biologist	4
☐ A forester from a company that produces forest products	0
☐ Logging contractor	2
☐ Other forest landowner	1
☐ Neighbors, friends, family	1
☐ Television/radio	0
☐ Magazine, newspaper, newsletter	2
☐ Conservation/environmental organizations	2
☐ Internet/web	2
☐ Other: (please specify)	0

37- There are many different ways to learn about managing forest lands, what to do and how to do it. How useful would the following ways of learning about managing your forest lands be for you? MARK ONE FOR EACH ITEM.

	Very useful	Somewhat useful	Somewhat not useful	Not Useful
- Publications, books or pamphlets.....	8	4	2	3
- Newsletters, magazines, or newspaper.....	4	8	2	3
- Internet/web.....	1	7	0	7
- Conferences, workshops, or videoconferences.....	2	5	2	6
- Video tapes or DVDs for home viewing.....	1	4	4	6
- Television or radio programs.....	1	3	5	6
- Visiting other forest lands or field trips.....	1	6	3	6
- Short courses with support materials0.....	1	4	4	5
- Talking with a forester or other natural resource professional	2	9	1	3
- Talking with other forest land owners.....	1	8	0	6
- Talking with a logging contractor.....	0	3	5	7
- Membership in a land owner organization.....	1	4	3	8
- Other: please specify				

38- Sometimes people are not able to use their forest land as they want to reach their objectives. Below are some issues that may affect your ability to use and/or enjoy your forest. Please indicate the level of importance of the following issues for reaching your objectives in managing your forest land. MARK ONE BOX FOR EACH ITEM.

	Very Imp	Somewhat important	Som Unimp	Very Unimp
- Dealing with endangered species……..	6	7	2	3
- Fear of lawsuits……	4	3	4	5
- Regulations that restrict harvests……..	3	3	7	5
- High property taxes……..	5	4	5	4
- Not enough financial means to afford management costs	4	3	5	4
- Development of nearby lands……	5	4	4	5
- Trespassing and/or poaching……	6	6	2	3
- People stealing my trees……..	6	2	4	6
- Not enough time to allocate to forest management tasks..	4	7	4	3
- Not enough labor to allocate to forest management tasks.	4	4	4	5
- Too small acreage of forest land ……..	3	2	8	5
- Poor soil……..	0	7	6	5
- Damage or noise from motorized vehicles……	1	2	8	7
- Misuse of forest land, such as a vandalism or dumping….	3	2	6	5
- Keeping land intact for my children or other heirs……..	7	3	2	1
- Other: please specify … ……				

39- How important are each of the following sources of information in making decisions for managing your forest land? CHECK ONE BOX FOR EACH COMPONENT.

	Very Imp	Somewhat important	Som Unimp	Very Unimp
- Technical assistance (like direct help from a forester)	3	10	1	3
- Financial assistance (including cost-share programs)	3	4	6	3
- Short courses and other forms of educational programs	2	3	8	3
- Other: please specify ……				

40- Which of the following categories best describes you? CHECK ONE.

- ☐ I like to experiment with new ideas and be the first to try something new. **4**
- ☐ I am willing to try new things but don't like to be the first **2**
- ☐ I usually wait until something is tried by others and found to be useful before I adopt it. **6**
- ☐ I will adopt new things mainly when they are in common use by others. **2**
- ☐ I am reluctant to try new things and prefer to hold on to traditional ideas and products even if something better comes along. **2**

19 res:

41- What is your age?

I am …… years old.

Youngest: 40's
Oldest: 80's
Average: 65

42- What is your level of education?

- ☐ less than 12th grade **2**
- ☐ High school graduate or GED **4**
- ☐ Some college education **0**
- ☐ Associate or technical degree **0**
- ☐ Bachelor's degree **6**
- ☐ Graduate degree **7**

43- What is your primary source of income?

- ☐ Non-land related employment **7**
- ☐ Not applicable (retired) **8**
- ☐ Farming **3**
- ☐ Timber harvest **0**
- ☐ Other: (please specify) …… **1**

44- What is your household's annual income?

- ☐ less than $25,000 **1**
- ☐ $25,000 to $49,999 **4**
- ☐ $50,000 to $99,999 **6**
- ☐ $100,000 to $199,999 **3**
- ☐ $200,000 or more **1**

45- What percent of your total income is earned with any activities related to your forest land?

Approximately, …… % of my total income is from my forest land.

18 res: min: 2%; max: 10% (Avg: 1%)

OPTIONAL: We are interested in learning more about your answers to the items in this questionnaire. If you would be willing to participate later this fall in a discussion during a short evening meeting, please write your phone number here: ( ) …… This is NOT a request for telephone solicitation purposes. Your phone number will not be shared with anyone.

Thank you so much for your help

Appendix D: Focus group agenda

I- Introduction

a- Welcome and brief introduction of all participants: Name, landowner/not landowner in Virginia.

b- Meeting purpose

- Overview of the research purpose: Understand how and why NIPFL adopt or do not adopt forestry practices
- Pilot test purpose: test the questionnaire,
- Focus group purpose: get more input from respondents in order to finalize the questionnaire for the survey.

II- Presentation of the results from the pilot test:

Brief presentation and statistics from the pilot test: handouts and/or some powerpoint slides. (acreage, participation in educational program, written management plan, use of professional help in managing land, etc.)

III- Topic areas and discussion questions

a- How did you interpret question 1 (Do you own any forest land in Virginia?). Could it be confusing?

b- About question 3 (yearly $ invested on forest land)

IV- presentation and format of the questionnaire:

- How long did it take you to fill the questionnaire out?
- How do you find its length? Any suggestions?
- How do you find the font used?
- What about spacing? Do we need more blank spaces?
- Is the format appropriate as it is (legal paper booklet)? Any suggestions
- Any other remarks, comments or suggestions?

IV- Closing:

Thanks and signup sheet for contact and participation.

VirginiaTech
College of Natural Resources

Department of Forestry
228 Cheatham Hall (0324)
Blacksburg, Virginia 24061
E-mail: mamiaina@vt.edu

April 21, 2007

Appendix E: Cover letter for the actual survey

Dear Virginia Forest Landowner,

As a forest landowner, you play a critical role sustaining Virginia's forests, and the many benefits forests provide. Virginia Tech has been working with forest landowners for many years. In order to better serve you, we need to learn why and how you manage your forest, as well as learn about your interests and expectations of the numerous programs we offer. In order to advise local, state, and federal programs, we need to understand how these programs and polices affect you and your ability to sustain your forest.

We selected your name from our Extension Service list of forest landowners as someone we needed to contact. Please complete and return the enclosed questionnaire as soon as possible in the stamped envelope that is provided. The questionnaire asks you about:

- Your goals for owning forest land,
- How you manage your forest land,
- Your informational needs,
- Factors limiting your ability to manage your forest to achieve your goals,
- Demographics.

Your responses will be anonymous and confidential. We will NOT share your name with anyone and we will not associate your name with any of the information you provide. So please be honest and feel free to be critical.

We will share the results of this survey with relevant policy makers and summarize them in the *Virginia Landowner Update*, which you already receive. Thank you for your help with this important task.

Sincerely yours,

Dr. Bruce Hull
Professor
Department of Forestry

Mami Rasamoelina
Graduate Research Assistant,
Department of Forestry

Appendix F: Reminder card

May 16, 2007

Dear forest landowner,

About a month ago, we sent you a questionnaire about Virginia forest landowners called "*2007 Survey of Virginia Forest Landowners.*" We selected your name from a list of forest landowners we really need to contact.

We very much need your questionnaire returned if the results are to accurately represent the population of Virginia forest landowners.

If you did not receive the questionnaire, or got it misplaced, please call me at (540)-200-3598 or send an e-mail at mamiaina@vt.edu and I will get another one in the mail to you immediately.

Sincerely,

Mami Rasamoelina
Virginia Tech, Department of Forestry

Respondent's address

VirginiaTech
College of Natural Resources

Department of Forestry
228 Cheatham Hall (0324)
Blacksburg, Virginia 24061

June 05, 2007

Appendix G: Final reminder (sent with the second survey booklet)

Dear Virginia Forest Landowner,

Several weeks ago we sent you some questions about your forest land and your needs for forest management advice. Our records indicate that you have not yet returned your answers. Many people have already returned the completed questionnaire to us, and we want to make sure you have an opportunity to reply so that our results represent your concerns.

You may have misplaced the first copy of the questionnaire that you received originally. Enclosed with this letter is another copy, with a postage-paid return envelope for your convenience. If you have already returned the questionnaire to us, please disregard this letter and accept our thanks for your help.

In order to better serve you and help sustain Virginia's forests, we need to learn why and how you manage your forest, as well as learn about your interests and expectations of the numerous programs we offer. Your responses will be confidential. We will NOT share your name with anyone and we will not associate your name with any of the information you provide. So please be honest and feel free to be critical.

We will share the results of this survey with relevant policy makers and summarize them in the *Virginia Landowner Update*, which you already receive. Thank you for your help with this important task.

If our records are incorrect and you did not own any forest land in Virginia at any time during the last 10 years, or if for any other reason, you do not wish to participate in this study, please write the reason on the back of the questionnaire and return it to us in the enclosed postage-paid envelope. We will remove your name from our mailing list.

Sincerely yours,

Dr. Bruce Hull
Professor
Department of Forestry
hullrb@vt.edu

Mami Rasamoelina
Graduate Research Assistant,
Department of Forestry
mamiaina@vt.edu

Appendix H: Final Questionnaire

2007 SURVEY OF VIRGINIA FOREST LANDOWNERS

VirginiaTech
College of Natural Resources
Department of Forestry
Cheatham Hall (0324)
Blacksburg, Virginia 24061

FOR THE PURPOSE OF THIS SURVEY, WE CONSIDER "FOREST LAND" TO BE ANY LAND WITH TREES, OF AT LEAST 2 ACRES OF AREA, WITH OR WITHOUT MARKETABLE TIMBER, AND WHETHER OR NOT IT IS (WAS) ALSO GRAZED. ALL QUESTIONS APPLY TO ANY FOREST LAND YOU CURRENTLY OWN AND/OR LAND YOU OWNED AT **ANY TIME IN THE LAST 10 YEARS** (SINCE JANUARY 1997) **IN THE COMMONWEALTH OF VIRGINIA**.

Section 1: The forest land

1- a/ Have you owned any forest land in Virginia at any time in the last 10 years (since January 1997)?

☐ Yes
☐ No

IF YOU DID NOT OWN ANY FOREST LAND AT ANY TIME IN THE PAST 10 YEARS, PLEASE **SKIP TO SECTION 4** OF THE QUESTIONNAIRE.

b/ How many acres of forest land do (did) you own?
I own (owned) _____ acres of forest land (total acres of all parcels owned).

c/ How many different tracts of forest land did (do) you own? I own (owned) _____ tracts of forest land.

2- If you own (owned) any forest land at any time in the past 10 years, PLEASE COMPLETE PARTS a/ and b/ BELOW:

a/ What year did you first acquire forest land? Year: _____...

b/ What year did you last own forest land? Year:_____...

3- For the purpose of this survey, a farm is a place where, in most years, income is earned from the sale of crops (other than forest products) or animals. Do (did) you own a farm that is (was) within one mile of your forest land?

☐ I did (do) not own a farm.
☐ I did (do) own a farm that is part of the same property as my forest land.
☐ I did (do) own a farm that is (was) approximately _____ miles from my nearest forest land.

4- Please check **ONE** of the two following statements?

☐ My home (primary residence) is/was part of the same property as one of my forest land.
☐ My home (primary residence) is/was _____ miles from my nearest forest land.

5- a/ Please fill out the following table in order to estimate the labor used in the management of your forest land.

season	Winter	Spring	Summer	Fall
Check ALL columns corresponding to the seasons when you are (were) conducting any activities related to the management of your forest land (e.g. thinning, maintaining roads, prescribed burning, etc)	☐	☐	☐	☐
How many WEEKS per season were/are those activities conducted on your land?				
On average, how many days did residents of your household participate in the activities listed above?				
On average how many people from **outside** your household did/are you hiring for those activities? (average number of people per week per season).				
On average, how many hours per week per person are allocated to those activities?				

b/ Do (did) you participate in those activities yourself?

☐ Yes
☐ No

6- People own forest land for many reasons. How important are (were) the following as reasons for why you own forest land? MARK **ONE** BOX FOR EACH ITEM (n/a = not applicable)

	Very Important	Somewhat important	Somewhat Unimport	Very Unimport	n/a
- To enjoy beauty or scenery……	☐	☐	☐	☐	☐
- To protect nature and its diverse animal and plant species…	☐	☐	☐	☐	☐
- For land investment (real estate)…... ……	☐	☐	☐	☐	☐
- Part of my home ……	☐	☐	☐	☐	☐
- Part of my vacation home……	☐	☐	☐	☐	☐
- Part of my farm……	☐	☐	☐	☐	☐
- For privacy……	☐	☐	☐	☐	☐
- To pass land on to my children or other heirs……	☐	☐	☐	☐	☐
- For cultivation/collection of non timber forest products	☐	☐	☐	☐	☐
- For production of energy (firewood, biofuel)	☐	☐	☐	☐	☐
- For production of sawlogs, pulpwood or other timber products	☐	☐	☐	☐	☐
- For hunting or fishing……	☐	☐	☐	☐	☐
- For recreation other than fishing and hunting……	☐	☐	☐	☐	☐
- As retirement fund	☐	☐	☐	☐	☐
- To supplement yearly income……	☐	☐	☐	☐	☐
- To have a healthy lifestyle ……	☐	☐	☐	☐	☐
- Other: please specify ……	☐	☐	☐	☐	☐

Section 2: Activities related to the management of forest land at the time you owned forest land

In this survey, "**professional help**" includes any kind of help received from an expert related to woodland management, wildlife management, or timber harvesting and marketing.

7- a/ Since 1997, have you ever used any professional help for managing any of your forest land?

☐ Yes
☐ No

IF YES, PLEASE COMPLETE PARTS b/ and c/ BELOW; IF NO, PLEASE SKIP TO QUESTION 8

b/ From whom did you receive professional help? CHECK **ALL** THAT APPLY

☐ Private consulting forester
☐ Private consulting wildlife specialist
☐ Virginia Department Of Forestry (forester)
☐ Virginia Department of Game and Inland Fisheries (biologist)
☐ Forest industry landowner assistance program
☐ Extension agent
☐ Certified public accountant
☐ Lawyer
☐ Logging firm or timber buyer
☐ Other: (please specify) ……

c/ What type of professional help did you receive? CHECK **ALL** THAT APPLY

- ☐ Woodland management plan
- ☐ Wildlife management plan
- ☐ Timber sales and harvesting planning (timber marketing, sales assistance, etc)
- ☐ Fire wise or fire safe landscape management
- ☐ Forest health, invasive species, or insect management
- ☐ Real estate investment
- ☐ Non-timber business assistance (mushrooms, hunt lease, etc)
- ☐ Forest stand management (silviculture techniques)
- ☐ Reforestation and planting
- ☐ Recreation and aesthetic planning (hunting leases, recreation and conservation easements, etc)
- ☐ Taxes and estate planning
- ☐ Cost share program assistance
- ☐ Other (please specify) ……

8- Related to any of your forest land, which of the following applies (applied) to you? CHECK **ONE**

- ☐ I have a written management plan that I am following (implementing).
- ☐ I have a written management plan and I am somewhat following it (not following it fully)
- ☐ I have a written management plan that I don't use.
- ☐ I am currently developing a written management plan.
- ☐ I don't have a plan but I am interested in having one.
- ☐ I don't have a written management plan and I am not interested in having one.

9- If you do (did) not have a written management plan, could you please give the reasons? CHECK **ALL** THAT APPLY

- ☐ I never thought about it.
- ☐ It is too expensive.
- ☐ I prefer doing something else with the amount of money that its implementation would require.
- ☐ I cannot afford the cost of implementing it fully.
- ☐ It is not necessary for managing my forest land; I manage my land in a traditional way.
- ☐ I don't own enough land to worry about managing it.
- ☐ I do not have the knowledge to develop it.
- ☐ I will have one, but it is not my priority yet.
- ☐ I don't spend enough time on my land to keep up with managing it.
- ☐ I am not physically able to implement it.
- ☐ I have the expertise to manage my forest land without using a written management plan.
- ☐ I do not trust foresters or people associated with timber sales.
- ☐ Other (please specify) ……

10- a/ Have trees ever been harvested or removed from any of your forest land in the last 10 years (since 1997)?

- ☐ Yes
- ☐ No

IF YES, PLEASE COMPLETE PARTS b/, c/ and d/ BELOW; IF NO, PLEASE GO TO QUESTION 11

b/ Why were trees harvested or removed? CHECK **ALL** THAT APPLY

- ☐ To achieve objectives in my management plan
- ☐ Trees were mature
- ☐ To generate money for an emergency (e.g. health-related emergency, etc)
- ☐ To generate a regular flow of income
- ☐ To obtain products for personal use (firewood, building materials, etc)
- ☐ To clear land for conversion to another use (e.g. road, building, pasture, etc)
- ☐ To minimize risk of wildfire
- ☐ To improve forest health
- ☐ Price was right
- ☐ To improve hunting opportunities
- ☐ To improve scenery and recreational opportunities
- ☐ To remove trees damaged by natural catastrophe
- ☐ To improve marketability of remaining trees
- ☐ To allow for creation of a new, young forest
- ☐ Other (please specify) ……

c/ Related to the most recent harvest on any of your forest land, which of the following practices happened as part of conducting a timber harvest on your land? Please CHECK **ALL** THAT APPLY

- ☐ You marked the trees prior to the harvest
- ☐ You estimated the volume of timber products to sell prior to the harvest
- ☐ You had a written contract for timber selling
- ☐ A professional forester marked the trees prior to the harvest
- ☐ A professional forester estimated the volume of timber products to sell prior to the harvest
- ☐ A logger harvested timber without any written contract

d/ Which of the following types of harvesting practices have you ever used when harvesting on your forest land?
CHECK **ALL** THAT APPLY

- ☐ Remove all of the trees in a large area (more than 2 acres) at one time.
- ☐ Harvesting small group of trees where the groups are 2 acres or less.
- ☐ Most of the trees in an area are harvested but a few selected by a forester are left to provide a seed source.
- ☐ Individual trees are selected for harvest, old or sick trees mainly, dispersed throughout the forest.
- ☐ All trees of at least a certain diameter are removed (please specify:…… inches diameter).
- ☐ Logger chooses which trees to cut.

11- a/ Do (did) you use any of your forest land for wildlife management purposes?

- ☐ Yes
- ☐ No

IF YES, PLEASE COMPLETE PART b/ BELOW; IF NO, PLEASE GO TO QUESTION 12

b/ Which of the following practices have you ever used on any of your forest land to manage wildlife habitat? CHECK **ALL** THAT APPLY

- ☐ Management of certain tree species: those providing food for wildlife over others.
- ☐ Protection of habitat by creating fire lines,
- ☐ Controlling invasive species (plant as well as animal)
- ☐ Placing nesting boxes
- ☐ Placing food plots
- ☐ Installing ponds or water holes
- ☐ Protecting special places like springs and pools
- ☐ Remove habitat to discourage certain species (i.e. beaver, deer)
- ☐ Protect vegetation against damages by noxious species (i.e. beaver, deer)
- ☐ Other: (please specify) .....

12- Since 1997, have any of the following activities occurred on any of the forest land? CHECK **ALL** THAT APPLY

- ☐ Prepared land for new trees (site preparation)
- ☐ Planted trees
- ☐ Thinned trees
- ☐ Pruned trees
- ☐ Applied herbicides, pesticides, or fertilizers
- ☐ Controlled exotic species
- ☐ Maintained roads and culverts
- ☐ Built or performed maintenance on roads or trails
- ☐ None of the above
- ☐ Posted land to restrict public access
- ☐ Maintained painted boundary lines
- ☐ Conducted a boundary line survey
- ☐ Put up gates
- ☐ Reduced fire hazard
- ☐ Prescribed burning
- ☐ Used fire lanes
- ☐ Protected cultural features like cemeteries
- ☐ Other (please specify) .....

Best Management Practices (BMPs) are practices chosen to reduce erosion and prevent and/or control pollution resulting from forestry operations (harvesting), BMPs include activities such as road construction minimizing erosion, streamside management zones, skid trails, revegetation of disturbed areas, etc.

13- a/ Given the above definition, are (were) you aware that Virginia Department of Forestry recommends Best Management Practices for anyone harvesting timber?

- ☐ Yes
- ☐ No

IF YES, PLEASE COMPLETE PART b/ BELOW; IF NO, PLEASE GO TO QUESTION 14

b/ Do (did) you use those practices on your forest land?

- ☐ Yes
- ☐ No
- ☐ I do not know

14- a/ Cost-share programs are programs providing landowners with money to help plant trees or manage their forest land (a list of the programs is given in question 17-b). Since 1997, have you ever used any cost-share program to help manage your forest?

- ☐ Yes
- ☐ No

IF YES, PLEASE COMPLETE PARTS b/ and c/ BELOW; IF NO, PLEASE SKIP TO QUESTION 15.

b/ Which of the following cost-share programs have you ever used for any of your forest land? CHECK **ALL** THAT APPLY

- ☐ Reforestation of timberlands (RT)
- ☐ Environmental quality incentives program (EQIP)
- ☐ Forest land enhancement program (FLEP)
- ☐ Virginia agricultural BMP cost share program
- ☐ Virginia BMP tax credit program
- ☐ Nutrient management equipment tax credit program
- ☐ Conservation reserve program (CRP)
- ☐ Conservation reserve enhancement program (CREP)
- ☐ Forestry incentives program (FIP)
- ☐ Wildlife habitat incentives program (WHIP)
- ☐ Partners for fish and wildlife (PFW)
- ☐ Wetlands reserve program (WRP)

c/ Since 1997, what is the approximate amount of support that you received for using a state or federal sponsored cost-share program to help you manage your forest land?

$ ..... (total amount in the last 10 years).

15- a/ Conservation easements are legally binding agreements that sometimes result in payments to owners that restrict land from being used for certain, designated purposes, such as development. Is (was) there a conservation easement on any of your forest land?

- ☐ Yes
- ☐ No

IF YES, PLEASE COMPLETE PART b/ BELOW; IF NO, PLEASE GO TO QUESTION 16.

b/ What types of activities are (were) restricted? CHECK **ALL** THAT APPLY

- ☐ Conversion of forest land to another land use
- ☐ Splitting of forest land into smaller land holdings
- ☐ Harvesting of trees
- ☐ Building houses or other structures
- ☐ Building roads
- ☐ Other (please specify) ....

Section 3: Sources of information related to forest land management

16- a/ Since 1997, have you ever received any information and/or advice of any sort about managing your forest land?

☐ Yes
☐ No

IF YES, PLEASE COMPLETE PARTS b/ and c/ BELOW; IF NO, PLEASE GO TO QUESTION 17

b/ What sources of information have you ever used to get information for managing your forest land? CHECK **ALL** THAT APPLY.

☐ Virginia Department of Forestry
☐ Lawn and garden company
☐ Arborist
☐ Extension forester or other university employee
☐ Private consultant, such as a forester or a biologist
☐ A forester from a company that produces forest products
☐ Local government
☐ Logging contractor
☐ Other forest landowner
☐ Neighbors, friends, family
☐ Television/radio
☐ Magazine, newspaper, newsletter
☐ Conservation/environmental organizations
☐ Internet/web
☐ Other: (please specify) ....

c/ There are many different ways to learn about managing forest lands, what to do and how to do it. How useful would the following ways of learning about managing your forest lands be for you? MARK **ONE** BOX FOR EACH ITEM

	Very useful	Somewhat useful	Somewhat not useful	Not useful at all	Don't know
- Publications, books or pamphlets.....	☐	☐	☐	☐	☐
- Newsletters, magazines, or newspaper…	☐	☐	☐	☐	☐
- Internet/web.....	☐	☐	☐	☐	☐
- Conferences or videoconferences.....	☐	☐	☐	☐	☐
- Video tapes or DVDs for home viewing.....	☐	☐	☐	☐	☐
- Television or radio programs.....	☐	☐	☐	☐	☐
- Visiting other forest lands or field trips.....	☐	☐	☐	☐	☐
- Attended workshops/short courses with support materials	☐	☐	☐	☐	☐
- Talking with a forester or other natural resource professional	☐	☐	☐	☐	☐
- Talking with other forest land owners.....	☐	☐	☐	☐	☐
- Talking with a logging contractor.....	☐	☐	☐	☐	☐
- Membership in a land owner organization…	☐	☐	☐	☐	☐
- Other: please specify	☐	☐	☐	☐	☐

In the following question, "**educational programs**" include all forms of FORMAL programs provided by experts, related to the management of your forest land; for instance shortcourses, workshops, organized bus tours, etc.

17- Given the above definition, in the last 10 years (since 1997) how often have you attended any educational program (short courses, field tours, seminars, conferences, etc) related to the management of your forest land? PLEASE CHECK **ONE**

☐ More than 10 times
☐ 6 to 10 times
☐ 2 to 5 times
☐ Once
☐ Never

18- How important are (were) each of the following sources of information in making decisions for managing your forest land? CHECK **ONE** BOX FOR EACH ITEM.

	Very Important	Somewhat important	Somewhat Unimportant	Very Unimportant
- Technical assistance (like direct help from a forester)	☐	☐	☐	☐
- Financial assistance (including cost-share programs)	☐	☐	☐	☐
- Formal educational programs/ materials (shortcourses, workshops, bus tours, etc)	☐	☐	☐	☐
- Other: please specify	☐	☐	☐	☐

19- Which of the following categories best describes (described) you at the time you owned forest land? CHECK **ONE**.

☐ I like to experiment with new ideas and be the first to try something new.
☐ I am willing to try new things but don't like to be the first.
☐ I usually wait until something is tried by others and found to be useful before I adopt it.
☐ I will adopt new things mainly when they are in common use by others.
☐ I prefer traditional ideas and products to new ones.

20- Things sometimes limit you from doing what you want on your land. Please indicate how limiting each of the following issues was in preventing you from achieving your objectives (currently or in the past 10 years). MARK **ONE** BOX FOR EACH ITEM, (n/a = not applicable).

	Very limiting	Somewhat limiting	Not limiting	n/a
- Dealing with endangered species……	☐	☐	☐	☐
- Fear of lawsuits……	☐	☐	☐	☐
- Regulations that restrict harvests……	☐	☐	☐	☐
- Insufficient profit from management or harvest	☐	☐	☐	☐
- No local market for the forest products I wanted to sell	☐	☐	☐	☐
- High property taxes……	☐	☐	☐	☐
- Not enough financial means to afford management costs	☐	☐	☐	☐
- Development of nearby lands……	☐	☐	☐	☐
- Trespassing, poaching and dumping……	☐	☐	☐	☐
- People stealing my trees……	☐	☐	☐	☐
- Not enough time to allocate to forest management tasks.	☐	☐	☐	☐
- Not enough labor to allocate to forest management tasks.	☐	☐	☐	☐
- Too small acreage to make management worthwhile	☐	☐	☐	☐
- Soil (poor soil or wet soil)……	☐	☐	☐	☐
- Damage or noise from motorized vehicles……	☐	☐	☐	☐
- Concerns about environmental damages caused by harvesting equipments	☐	☐	☐	☐
- Neighbors complain about forest management	☐	☐	☐	☐
- Difficulty finding professional forestry advice	☐	☐	☐	☐
- Managing my land is not cost effective	☐	☐	☐	☐
- Difficulty finding logger or other service provider with equipment, time, and willingness to work on my property	☐	☐	☐	☐
- Other: please specify ……	☐	☐	☐	☐

Section 4: Demographics

21- What is your age?
I am currently …… years old.

22- What is (was) your level of education?

- ☐ less than 12th grade
- ☐ High school graduate or GED
- ☐ Some college education
- ☐ Associate or technical degree
- ☐ Bachelor's degree
- ☐ Graduate degree

23- Please fill in the blank

Approximately _____% of my total income is generated by activities on from my forest land.

24- What is your household's annual total income?

- ☐ less than $25,000
- ☐ $25,000 to $49,999
- ☐ $50,000 to $99,999
- ☐ $100,000 to $199,999
- ☐ $200,000 or more

Instruction on how to return the questionnaire back to us:
After you finished filling this questionnaire out, please put it in the stamped envelope we sent you and return it to us.

If you have any question, you can contact us at:

Address: Mami Rasamoelina
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Tel: 540-231-7272

Thank you so much for your help

Appendix I: Frequency table for the use of a written management plan

	Frequency	Percent
No written management plan and not interested in having one.	405	38.9
No written management but I am interested in having one.	268	25.7
Currently developing a written management plan.	47	4.5
With a written management plan but not use it.	33	3.2
With a written management plan and somewhat following it (not implementing it fully)	160	15.4
With a written management plan and following it (implementing).	128	12.3
Total	1041	

Appendix J: Descriptive table for demographics across the three groups of educational programs

		N	Mean	Std. Deviation	Min.	Max.
Age	No educational program	308	64.59	11.628	28	98
	VFLEP Attendees	477	62.41	12.176	34	95
	Other educational programs	280	60.15	11.927	26	89
	Total	1065	62.45	12.057	26	98
Level of education	No educational program	309	3.61	1.695	1	6
	VFLEP Attendees	480	4.41	1.488	1	6
	Other educational programs	283	4.65	1.410	1	6
	Total	1072	4.24	1.585	1	6
% income earned from forest	No educational program	278	2.36	9.740	0	100
	VFLEP Attendees	453	2.57	8.132	0	100
	Other educational programs	266	4.27	9.575	0	66
	Total	997	2.97	9.023	0	100
Household income	No educational program	267	2.81	1.169	1	5
	VFLEP Attendees	432	3.06	1.067	1	5
	Other educational programs	258	3.23	1.020	1	5
	Total	957	3.03	1.094	1	5

Appendix K: Descriptive table for characteristics across the three groups of educational programs

		N	Mean	Std. deviation	Min	Max.
Acreage	No educational program	302	134.78	243.53	3	2300
	VFLEP attendees	459	219.38	336.61	2	3000
	Other educational programs	267	135.61	293.23	3	2900
	Total	1028	172.77	303.21	2	3000
Distance between forest and home	No educational program	282	30.15	299.16	0	5000
	VFLEP attendees	388	26.45	161.77	0	3000
	Other educational programs	243	11.51	35.15	0	350
	Total	913	23.62	197.65	0	5000

Self-rated attitude toward innovation	No educational program		267	2.61	1.51	0	5
	VFLEP attendees		449	3.17	1.40	0	5
	Other educational programs		281	3.34	1.36	0	5
		Total	997	3.07	1.45	0	5

Appendix L: Descriptive table for motivations across the three groups of educational programs

			N	Mean	Std. dev.	Min.	Max
Amenity motivations	No educational program		312	-.12	1.08	-2.96	1.85
	VFLEP attendees		487	.09	.93	-2.91	1.70
	Other educational programs		285	-.02	.99	-2.83	1.71
		Total	1084	.00	1.00	-2.96	1.85
Economic motivations	No educational program		312	-.20	.99	-2.36	2.41
	VFLEP attendees		487	.24	.96	-2.77	2.08
	Other educational programs		285	-.19	.97	-2.43	2.28
		Total	1084	.00	1.00	-2.77	2.41
Farming-related motivations	No educational program		312	.00	1.02	-2.01	1.91
	VFLEP attendees		487	-.00	.96	-2.02	1.65
	Other educational programs		285	.01	1.03	-1.87	1.82
		Total	1084	.00	1.00	-2.02	1.91
Recreation motivations	No educational program		312	-.08	1.02	-2.61	2.64
	VFLEP attendees		487	.03	.96	-2.53	2.85
	Other educational programs		285	.04	1.03	-2.29	2.84
		Total	1084	.00	1.00	-2.61	2.85

Appendix M: Descriptive table for information providers across the three groups

		N	Mean	Std. dev.	Min.	Max.
Virginia Department of Forestry	No educational program	305	.27	.442	0	1
	VFLEP attendees	476	.55	.498	0	1
	Other educational programs	287	.80	.397	0	1
	Total	1068	.54	.499	0	1
Lawn and garden company	No educational program	305	.03	.160	0	1
	VFLEP attendees	476	.03	.180	0	1
	Other educational programs	287	.03	.165	0	1
	Total	1068	.03	.171	0	1
Arborist	No educational program	305	.01	.081	0	1
	VFLEP attendees	476	.05	.215	0	1
	Other educational programs	287	.05	.223	0	1
	Total	1068	.04	.190	0	1
Extension forester or other university employee	No educational program	305	.08	.270	0	1
	VFLEP attendees	476	.25	.432	0	1
	Other educational programs	287	.28	.451	0	1
	Total	1068	.21	.407	0	1
Private consultant, such as a forester/biologist	No educational program	305	.12	.323	0	1

	VFLEP attendees	476	.25	.432	0	1
	Other educational programs	287	.39	.489	0	1
	Total	1068	.25	.433	0	1
Forester from a company producing forest products	No educational program	305	.03	.178	0	1
	VFLEP attendees	476	.09	.293	0	1
	Other educational programs	287	.16	.368	0	1
	Total	1068	.09	.293	0	1
Local government	No educational program	305	.02	.127	0	1
	VFLEP attendees	476	.02	.150	0	1
	Other educational programs	287	.03	.165	0	1
	Total	1068	.02	.148	0	1
Logging contractor	No educational program	305	.07	.248	0	1
	VFLEP attendees	476	.09	.281	0	1
	Other educational programs	287	.13	.336	0	1
	Total	1068	.09	.289	0	1
Other forest landowner	No educational program	305	.06	.230	0	1
	VFLEP attendees	476	.13	.341	0	1
	Other educational programs	287	.20	.400	0	1
	Total	1068	.13	.336	0	1
Neighbors, friends, family	No educational program	305	.07	.254	0	1
	VFLEP attendees	476	.14	.350	0	1
	Other educational programs	287	.17	.377	0	1
	Total	1068	.13	.336	0	1
Television/radio	No educational program	305	.02	.150	0	1
	VFLEP attendees	476	.02	.150	0	1
	Other educational programs	287	.04	.192	0	1
	Total	1068	.03	.163	0	1
Magazine, newspaper, newsletter	No educational program	305	.10	.298	0	1
	VFLEP attendees	476	.21	.405	0	1
	Other educational programs	287	.34	.474	0	1
	Total	1068	.21	.408	0	1
Conservation/environmental organizations	No educational program	305	.04	.195	0	1
	VFLEP attendees	476	.13	.335	0	1
	Other educational programs	287	.19	.392	0	1
	Total	1068	.12	.324	0	1
Internet/web	No educational program	305	.04	.195	0	1
	VFLEP attendees	476	.11	.317	0	1
	Other educational programs	287	.17	.377	0	1
	Total	1068	.11	.310	0	1

Appendix N: Descriptive table for information channels across the three groups

		N	Mean	Std. dev.	Std. error	Min.	Max.
Books	No educational program	152	2.78	1.381	.112	0	4
	VFLEP attendees	353	3.20	1.138	.061	0	4
	Other educational programs	260	3.31	1.013	.063	0	4
	Total	765	3.15	1.165	.042	0	4
News/magazines/newspapers	No educational program	152	2.57	1.389	.113	0	4
	VFLEP attendees	353	3.03	1.167	.062	0	4
	Other educational programs	260	3.15	1.120	.069	0	4
	Total	765	2.98	1.216	.044	0	4
Internet	No educational program	152	1.82	1.519	.123	0	4
	VFLEP attendees	353	2.25	1.489	.079	0	4
	Other educational programs	260	2.18	1.516	.094	0	4
	Total	765	2.14	1.511	.055	0	4
Conferences	No educational program	152	1.20	1.245	.101	0	4
	VFLEP attendees	353	2.06	1.492	.079	0	4
	Other educational programs	260	2.19	1.425	.088	0	4
	Total	765	1.93	1.469	.053	0	4
DVD/video	No educational program	152	1.57	1.459	.118	0	4
	VFLEP attendees	353	1.99	1.503	.080	0	4
	Other educational programs	260	2.00	1.500	.093	0	4
	Total	765	1.91	1.501	.054	0	4
Television/radio	No educational program	152	1.63	1.370	.111	0	4
	VFLEP attendees	353	1.95	1.398	.074	0	4
	Other educational programs	260	1.99	1.377	.085	0	4
	Total	765	1.90	1.390	.050	0	4
Fieldtrips	No educational program	152	1.60	1.461	.119	0	4
	VFLEP attendees	353	2.59	1.463	.078	0	4
	Other educational programs	260	2.77	1.386	.086	0	4
	Total	765	2.45	1.499	.054	0	4
Workshop/shortcourses	No educational program	152	1.49	1.424	.115	0	4
	VFLEP attendees	353	2.92	1.351	.072	0	4
	Other educational programs	260	3.03	1.313	.081	0	4
	Total	765	2.67	1.475	.053	0	4
Interaction with a natural resource professional	No educational program	152	2.45	1.594	.129	0	4
	VFLEP attendees	353	3.32	1.146	.061	0	4
	Other educational programs	260	3.37	1.130	.070	0	4
	Total	765	3.16	1.291	.047	0	4
Peers	No educational program	152	1.93	1.495	.121	0	4
	VFLEP attendees	353	2.49	1.390	.074	0	4
	Other educational programs	260	2.62	1.369	.085	0	4
	Total	765	2.42	1.425	.052	0	4
Logging contractor	No educational program	152	1.53	1.386	.112	0	4
	VFLEP attendees	353	1.86	1.389	.074	0	4
	Other educational programs	260	2.03	1.386	.086	0	4
	Total	765	1.85	1.397	.051	0	4
Membership to an owner organization	No educational program	152	1.18	1.266	.103	0	4
	VFLEP attendees	353	1.69	1.457	.078	0	4
	Other educational programs	260	1.77	1.486	.092	0	4
	Total	765	1.62	1.447	.052	0	4

Appendix O: Descriptive table for constraints to active management across the three groups

		N	Mean	Std. dev.	Std. Error	Min.	Max.
Human-related constraints	No educational program	259	-.1292	1.06052	.06590	-3.08	2.67
	VFLEP attendees	435	-.0379	1.00005	.04795	-2.96	3.71
	Other educational programs	277	.1802	.91651	.05507	-3.12	2.61
	Total	971	.0000	1.00000	.03209	-3.12	3.71
Scale-related constraints	No educational program	259	-.1610	1.04181	.06474	-2.86	2.72
	VFLEP attendees	435	.0466	1.00777	.04832	-2.71	2.88
	Other educational programs	277	.0774	.93229	.05602	-2.75	2.80
	Total	971	.0000	1.00000	.03209	-2.86	2.88
Financial constraints	No educational program	259	-.1240	1.01398	.06301	-2.33	3.05
	VFLEP attendees	435	.0020	1.02132	.04897	-3.18	3.00
	Other educational programs	277	.1128	.94124	.05655	-2.15	2.99
	Total	971	.0000	1.00000	.03209	-3.18	3.05
Time/labor constraints	No educational program	259	-.1160	1.05500	.06555	-2.40	2.50
	VFLEP attendees	435	.0489	1.01212	.04853	-2.96	2.84
	Other educational programs	277	.0317	.91970	.05526	-2.21	2.43
	Total	971	.0000	1.00000	.03209	-2.96	2.84

Appendix P. Values of the independent variables used for computing the probability of adoption of practices.

Variables	PCA factor #	Categories	Range	Value used
Time/labor constraints	Factor 4 in analysis 3	Low	-2.95 to -0.58	-1.77
		Medium	-0.57 to 0.46	-0.05
		High	0.47 to 2.84	1.66
Human-related constraints	Factor 1 in analysis 3	Low	-3.12 to -0.37	-1.75
		Medium	-0.36 to 0.36	0
		High	0.37 to 3.7	2.04
Scale-related constraints	Factor 2 in analysis 3	Low	-2.85 to -0.3	-1.58
		Medium	-0.29 to 0.36	0.04
		High	0.37 to 2.87	1.62
Self-learning information	Factor 2 in analysis 2	Low	-2.79 to -0.4	-1.6
		Medium	-0.39 to 0.58	0.1
		High	0.59 to 2.41	1.5
Direct professional information	Factor 1 in analysis 2	Low	-2.96 to -0.23	-1.6
		Medium	-0.22 to 0.54	0.16
		High	0.55 to 2.42	1.49
Length of ownership		Short	Less than 10 years	5
		Medium	10 to 30 years	20
		Long	More than 30 years	30
Amenity motivations	Factor 1 in analysis 1	Low	-2.96 to -0.21	-1.59
		Medium	-.20 to 0.58	0.19
		High	0.59 to 1.85	1.22
Economic motivations	Factor 2 in analysis 1	Low	-2.77 to -0.48	-1.63
		Medium	-0.47 to 0.48	0.01
		High	0.49 to 2.40	1.45
Recreation motivations	Factor 4 in analysis 1	Low	-2.61 to -0.44	-1.53
		Medium	-0.43 to 0.37	-.03
		High	0.38 to 2.85	1.62
Income from forest		None	0	0
		Low	1-5%	2
		High	5% and over	5
Household income		Low	Less than 25000	1
		Medium	25000 to 99999	2.5
		High	100000 and plus	4.5
Educational programs		Never	0	0
		Rarely	Once to five times	3
		Somewhat frequently	6 to 10 times	8
		Frequently	More than 10 times	10

Appendix Q: Demographics of the respondents collected from the last wave of mailing

	N	Min	Max	Mean
Acreage	353	2	2855	156
Tracts	340	0	55	2
Length of tenure	359	0	64	25
Distance between home and forest	363	0	600	10
Age	373	32	91	62
Household income from forest-related activities (% total income)	348	0	100	4
Total household income	335	1	5	Between $50,000 and $99,000
Level of education	377	1	6	Associate/technical degree