FACTORS AFFECTING THE ADOPTION AND RETENTION OF CONSERVATION BUFFERS

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ABSTRACT

Despite the numerous environmental benefits of conservation buffers and incentives offered by cost-share programs, adoption remains low. Typical buffer designs often take arable land out of production. Multifunctional conservation buffers (MCBs) offer an alternative that supports rather than excludes production. By incorporating non-timber forest products (NTFPs), edible or ornamental crops can be harvested for profit or home use, while retaining key environmental services. Beyond low adoption rates, little is known about the long-term retention of conservation buffers due in part to limited program evaluation funding. However, implementation of evaluation recommendations is imperative for buffer retention. With this in mind, we administered a mail survey to conservation buffer adopters throughout Virginia. The first objective was to evaluate post-adoption experiences with conservation buffers. We identified four landowner clusters with distinct differences in buffer perceptions and intentions to retain. Insights can help conservation agencies enhance programming to reduce negative buffer experiences and increase long-term retention. The second objective was to determine interest in and preferences for MCBs. We found respondents were somewhat to very interested in MCBs, and increases in this interest were influenced most by the buffer's potential to decrease soil loss. Respondents who found MCBs more appealing than traditional designs had supportive peers and higher expectations of MCB performance. Lastly, respondents preferred MCBs designed with nut or fruit producing trees that grow naturally. Findings can help inform future outreach and programming aimed at merging conservation and production in buffer zones.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

1.1 Background

Conservation buffers are vegetated strips that are strategically positioned within a landscape to enhance aquatic and terrestrial wildlife habitat and improve and protect water, air and soil quality. There are several different types of conservation buffers, each focusing on a specific resource concern. Wildlife corridors, for example, are a continuous vegetated strip designed specifically to provide habitat, food and passage for wildlife (Bentrup 2008). Riparian forest buffers are vegetated streamside zones positioned between upland and aquatic habitats that are designed to address water quality issues, such as stream bank erosion and non-point source pollution.

Riparian forest buffers are one of five temperate agroforestry practices. The other four practices include alley cropping, silvopasture, windbreaks and forest farming. Agroforestry is defined as an interactive land management system that intentionally integrates and intensively manages trees and/or shrubs with crops and/or livestock (Gold and Garret 2009). As a result of their ecosystem services, conservation agencies recommend riparian forest buffers as a best management practice (BMP) and alternative to production in the floodplain (Lowrance et al. 1995). Government cost-share programs, like the FSA's Conservation Reserve Enhancement Program (CREP) and the NRCS's Environmental Quality Incentives Program (EQIP), pay farmers to establish conservation buffers under 2-15 year contracts.

1.2 Problem Statement

Despite cost-share incentives and numerous environmental benefits, conservation buffer adoption remains low (Skelton et al. 2005; Kenwick et al. 2009). Some argue that adoption rates are low because typical buffer design often takes arable land out of production (Robles-Diaz-de-

Leon 1998, Robles-Diaz-de-Leon and Nava-Tudela 1998). One potential alternative to the typical buffer design is to plant productive NTFPs, such as fruit, nut and floral trees and shrubs, in a MCB (Figure 1.1). Rather than preclude production, this agroforestry system supports production of edible and ornamental crops that can be harvested for profit or home use, while retaining key environmental services (Robles-Diaz-de-Leon 1998, Robles-Diaz-de-Leon and Nava-Tudela 1998). Many private landowners throughout the Appalachian Region are interested in adopting MCBs (Trozzo et al. 2013; 2014). Before programming can be developed for this agroforestry system, however, more information is needed about the opinions and preferences landowners have for MCBs.

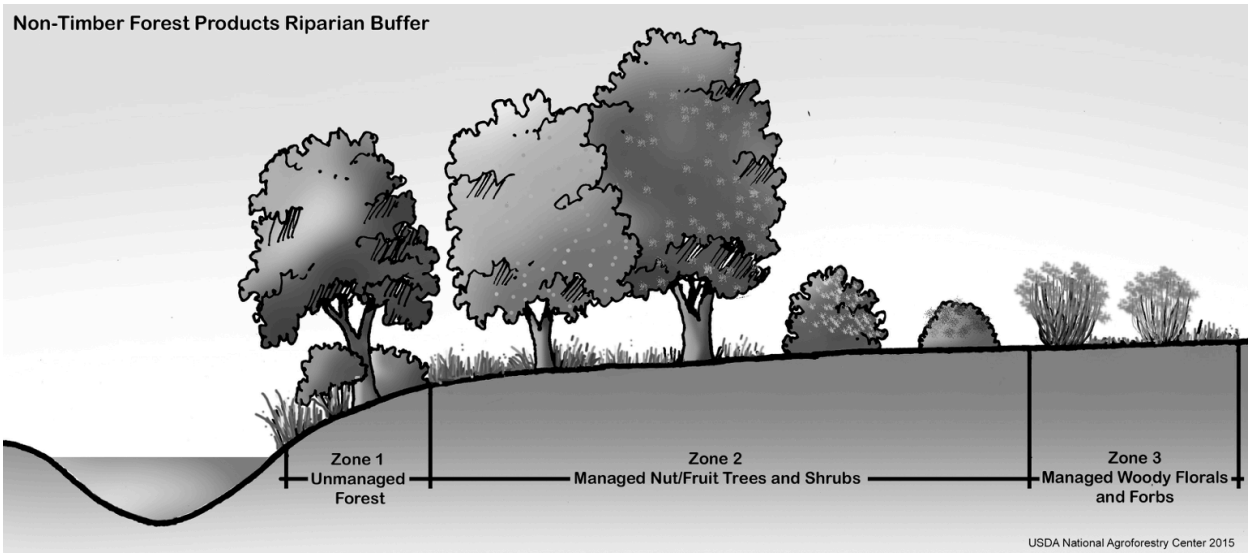

Figure 1.1. Example Design of a MCB (Bentrup 2015).

In addition to low adoption rates, a large percentage of conservation buffers have been removed throughout the eastern U.S., primarily for agricultural production (Allen et al. 2001). Furthermore, long-term retention of cost-share buffers that are implemented is largely unknown. Conservation agencies generally lack funding needed to comprehensively evaluate projects, and in turn, make program enhancements necessary for practice retention (Kleiman et al. 2000). In

addition, the 10% of conservation projects evaluated each year are limited to only those under contract. External evaluations, however, indicate that when buffers are implemented they are not always retained (e.g., Bradburn et al. 2010). Currently, many buffers are approaching contract termination and agencies are focusing efforts on re-enrollment and retention. For these efforts to be successful, however, insights into landowner perceptions are needed to inform cost-share program enhancements.

1.3 Objectives

The overarching goal of this study was to provide conservation agencies with insight into landowner perceptions of and preferences for conservation buffers to develop strategies for program enhancement. The first objective was to evaluate landowner perceptions of and intentions to retain conservation buffers. Results are expected to add insight to retention literature, by gauging the influence perceived land health impacts, maintenance effort, and negative financial impacts of a buffer have on intentions to retain. Findings may also help conservation agencies reduce negative buffer experiences and increase practice retention through program enhancements. The second objective of this study was to determine landowner preferences for native fruit, nut and floral trees and shrubs in MCBs. This included adoption interest, opinions of expected buffer performance, effort and risk, and species and management preferences. Findings are expected to inform future outreach and programming aimed at merging conservation and production in buffer zones.

1.4 Organization

Chapter 2 identifies the scientific contributions this study makes in a contextual review of relevant literature. Chapter 3 evaluates conservation buffer adopters' perceptions of and intentions to retain their buffer. Chapter 4 gauges landowner opinions of and preferences for

using native fruit, nut and floral trees and shrubs in MCBs. Chapter 5 summarizes study findings and provides recommendations for further research.

CHAPTER 2: LITERATURE REVIEW

2.1 Temperate Agroforestry

Agroforestry is the intentional integration and intensive management of trees and/or shrubs with crops and/or livestock. Many conservation buffers, including those with NTFPs, are considered a temperate agroforestry practice. A substantial amount of agroforestry research has focused on function and design (Lowrance et. al 1984; 2000; Gold and Garrett 2009; Schoeneberger 2009; Jose 2012), and until recently, has been conducted largely in tropical regions with little focus on adoption (Pattanayak et al. 2003).

The intensive and integrative nature of agroforestry requires a greater level of physical and intellectual investment from landowners than traditional agriculture (Mercer 2004), making scientific understanding of both agroforestry application *and* adoption preferences crucial in successful implementation of agroforestry projects (Pattanayak et al. 2003). Several recent studies fill this knowledge gap, by providing insight into agroforestry adoption preferences (Matthews et al. 1993; Raedeke et al. 2001; Strong and Jacobson 2005; Arbuckle et al. 2009; Barbieri and Valdivia 2010), including conservation buffers (Ryan et al. 2003; Skelton et al. 2005; Valdivia and Poulos 2009; Armstrong and Stedman 2012; Trozzo et al. 2013; 2014).

2.2 Conservation Buffers

Conservation buffers are vegetated strips strategically positioned within a landscape to enhance aquatic and terrestrial wildlife habitat and improve and protect water, air and soil quality. There are several types of conservation buffers, each focusing on a specific resource concern. Wildlife corridors, for example, are a continuous vegetated strip designed specifically to provide habitat, food and passage for wildlife (Bentrup 2008). Riparian forest buffers are vegetated streamside zones positioned between upland and aquatic habitats that are designed to

address water quality issues, such as stream bank erosion and non-point source pollution (Gold and Garrett 2009).

Research on conservation buffers spans across a wide range of fields, including agroforestry, environmental management, economics and urban planning (Featherstone and Goodwin 1993; Ryan et al. 2003; Kenwick et al. 2009; Armstrong and Stedman 2012; Trozzo et al. 2014). Numerous studies catalogue effectiveness of conservation buffers in water quality management (Lowrance et. al 1984; 2000; Mayer et al. 2007), as well as biodiversity and wildlife habitat enhancement (Jose 2012). Several economic evaluations have found promising net present values for conservation buffers (Robles-Diaz-De-Leon and Tudela 1998; Williams et al. 2004).

Although conservation buffers offer numerous benefits, adoption rates remain relatively low (Skelton et al. 2005; Kenwick et al. 2009) and a large percentage of natural and planted buffers have been removed throughout the eastern U.S. (Allen et al. 2001). This may be due to typical buffer design, which often takes arable land out of production. One suggested alternative is to plant productive NTFPs, such as fruit, nut and floral trees and shrubs, in a MCB. Rather than exclude production, this agroforestry system supports edible and ornamental crops that can be harvested for profit or home use, while retaining key environmental services (Robles-Diaz-de-Leon 1998; Trozzo et al. 2013; 2014). Economic analyses of MCBs indicate promising profitability (Robles-Diaz-De-Leon and Tudela 1998), and a recent study in the Appalachian Region of Virginia indicated interest in MCBs among many private landowners, specifically in riparian areas (Trozzo et al. 2013; 2104).

Our study presented the idea of using NTFPs in MCBs to conservation buffer adopters. Fruit producing trees and shrubs included: blueberry (*Vaccinium corymbosum*), elderberry (*Sambucus canadensis)*, black raspberry (*Rubus occidentalis*), blackberry (*Rubus alleganensis*),

pawpaw (*Asimina triloba)*, American persimmon (*Diospyros americana)* and American plum (*Prunus americana)*. Nut producing trees and shrubs included: American hazelnut (*Corylus americana)*, black walnut (*Juglans nigra*), and hickory (*Carya ovata*). Lastly, decorative woody cut florals included: hydrangea (*Hydrangea arborescens*), pussy willow (*Salix discolor*) and redosier dogwood (*Cornus sericea*). Cataloguing conservation buffer adopter's opinions of and preferences for these MCBs will contribute to adoption literature by adding experienced-based insight, which has not been studied in this regard. Findings will also inform future outreach and cost-share programming aimed at merging conservation and production in buffer zones.

2.3 Adoption of Agroforestry Practices and Conservation Buffers

Peer review literature outlines numerous factors that influence agroforestry adoption, including conservation buffers. Land characteristics such as the presence of stream bank erosion (Valdivia and Poulos 2009) and farm size (Featherstone and Goodwin 1993; Pattanayak et al. 2003; Strong and Jacobson 2005; Barbieri and Valdivia 2010; Trozzo et al. 2014) are thought to relate to conservation adoption. However, the relationships in general are less than clear. For instance, Napier et al. (2000) found that interest in BMPs, such as riparian buffers, is highest among large, high-income farms. Somewhat differently, Trozzo et al. (2014) observed greater interest in buffers among small, high-income landowners focused more on amenities than commodities. In between both, Armstrong and Stedman (2012) found no relationship between buffer adoption and parcel size.

Landowner characteristics have been studied for their influence on adoption as well. Socioeconomic traits such as age (Hagan 1996; Strong and Jacobson 2005; Valdivia and Poulos 2009), education (Hagan 1996; Arbuckle et al. 2009) and economic attributes (Featherstone and Goodwin 1993; Pattanayak et al. 2003; Raedeke et al. 2003) have been found to relate in one

way or another to conservation adoption, though again the nature and direction vary. Both Hagan (1996) and Valdivia and Poulos (2009) found that younger landowners are more interested in conservation buffers, while Trozzo et al. (2014) observed that age plays a limited role in MCBs. Similarly, Hagan (1996) found a positive relationship between higher education levels and buffer interest, while Armstrong and Stedman (2012) did not. Lastly, economic attributes, such as income levels, debt, and available credit, have been reported as influential factors in agroforestry adoption by some (Pattanayak et al. 2003), but not others (Valdivia and Poulos 2009).

Farming experience and knowledge of the conservation practice are additional landowner characteristics that have been studied with mixed results. For example, Armstrong and Stedman (2012) reported that knowledge of the practice does not appear to influence interest in buffer adoption, while Valdivia and Poulos (2009) found that it does. Furthermore, many studies have noted that more experienced farmers generally have greater interest in buffers when compared to less experienced farmers (e.g., Hagan 1996; Ryan et al. 2003). Yet some studies indicate that landowners that do not farm are typically more interested in agroforestry practices (Arbuckle et al. 2009; Trozzo et al. 2013; 2014).

Though farmers are often less interested in adoption, they are relatively most interested in riparian buffers when compared to other agroforestry practices. More specifically, small-scale, part-time farmers are generally the most inclined to adopt such practices (Buttel et al. 1981; Schrader 1995; Primdahl 1999; Ryan et al. 2003). Parallel to these findings are those of McCann et al. (1997) who found that organic farmers were often more interested than non-organic farmers, and Skelton et al. (2005) who observed that farmers with greater crop diversity were more apt to adopt agroforestry practices.

Beyond landowner demographics and socioeconomics, the role of social interaction and its link to agroforestry adoption has been studied (Pattanayak et al. 2003; Armstrong and Stedman 2012; Trozzo et al. 2014). Armstrong and Stedman (2012) found that agricultural producers are more likely than non-producers to adopt buffers if a friend has already done so. Moreover, Trozzo et al. (2014) observed that the opinions of family members and neighbors impact decisions to adopt, while Raedeke et al. (2003) noted the influence of family support. Pattanayak et al. (2003) found a similar relationship between an agricultural producer's interest in agroforestry and their membership in community organizations.

Expectations for the amount of work required to maintain buffers have also been shown to impact adoption (Pattanayak et al. 2003; Arbuckle et al. 2009; Valdivia and Poulos 2009). Studies show that concerns regarding buffer size**,** aesthetics and maintenance (Armstrong and Stedman 2012), and trust in government agencies (Raedeke et al. 2001) impair participation in buffer cost-share programs. Nevertheless, some hold optimistic outlooks on buffers, particularly when they provide crop yield and wildlife benefits (Trozzo et al. 2014).

Perceived impacts on land aesthetics are also linked to adoption of buffers (Ryan et al. 2003; Valdivia and Poulos 2009). If managed correctly, they portray good stewardship and a well-maintained farm (Nassauer 1988), but more often than not they are considered unattractive. Ryan (1998) reported that farmers found overgrown stream banks aesthetically messy and unappealing, and Carr and Tait (1991) noted that farmers would remove buffers in order to maintain an aesthetically pleasing farmscape. Furthermore, Ryan et al. (2003) found that woody plantings were less aesthetically appealing to farmers when compared to grass buffers.

Lastly, extrinsic motivations, or those driven by external pressures or rewards, and intrinsic motivations, or those driven by inherent interests, have been linked to agroforestry

adoption (Strong and Jacobson 2005; Arbuckle et al. 2009; Ryan et al. 2003; Valdivia and Poulos 2009). Ryan et al. (2003) reported that extrinsic benefits, such as cost-share payments, were not strongly associated with buffer adoption, but Trozzo et al. (2014) noted that interest in them grows when buffer-based production possibilities increase. Those with strong intrinsic motivations, such as land preservation for future generations and concern for downstream neighbors, are generally more interested in forest buffers (Ryan et al. 2003; Valdivia and Poulos 2009), as are landowners who value environmental benefits (Strong and Jacobson 2005; Arbuckle et al. 2009) and recreation (Arbuckle et al. 2009; Barbieri and Valdivia 2010).

The literature shows that various factors influence landowner adoption of agroforestry practices, but general consensus is often difficult to find. Nevertheless, key variables include landowner and land characteristics, social influences, and expected risks and benefits. Much of this research, however, focuses on landowners in general. As a result, preferences for MCBs among landowners with prior buffer experience are limited in peer review literature. By tailoring research to conservation buffer adopters, this study uses experienced-based insight to indicate opinions of and preferences for MCBs, a relatively new and unfamiliar practice. These findings can inform future outreach and programming aimed at merging conservation and production in buffer zones. Lastly, the role that MCBs could play in improving adoption of cost-share conservation plantings will be better understood across adopting landowners.

2.4 Conservation Buffer Evaluation

Program evaluation is defined as an assessment of program performance that measures successes and failures based on goal achievements, with results and recommendations distributed to applicable audiences (Clark and Brunner 1996). It is recommended that conservation program evaluations examine not only program accomplishments, but also the efficiency and

effectiveness of the program's operation and performance in order to identify accompanying consequences. Periodic internal and external evaluations and implementation of subsequent recommendations are imperative for increased program effectiveness, efficiency and long-term success. Despite the benefits, internal post-adoption evaluations of conservation buffer programs are infrequent. This is largely because conservation agencies lack the necessary funding to conduct follow-up evaluations (Kleiman et al. 2000). There are, however, several notable external evaluations of conservation buffers depicted in the scientific literature.

Several studies evaluate the survival rates of conservation buffers. Bradburn et al. (2010) evaluated riparian forest buffers established under the CREP and found limited tree survival in Ridge and Valley regions of Virginia, largely due to a combination of invasive species competition and excessive mowing and disking by landowners. Sweeney et al. (2002) noted plant competition and herbivore predation as key components to buffer survival. Similarly, Opperman and Merenlender (2000) cited herbivore predation of deer as a limitation to tree survival, while Ranganath et al. (2009) noted the importance of excluding livestock from planting sites.

Looking more closely at post-adoption experience and satisfaction, Vandever et al. (2002) evaluated Conservation Reserve Program (CRP) participants and discovered satisfaction with ecosystem services, such as soil retention and increased wildlife sightings, but dissatisfaction from those who perceived their conservation zones as a weed source. Evaluating the Landowner Incentive Program (LIP), Knipps (2011) found that most participants in Texas would apply for the program again, indicating that their project goals had been achieved. Participants saw an enhancement in wildlife habitat, but did not see an increase in land-based income due to program participation. Similarly, Rossi et al. (2010) found that most participants

of a pine beetle prevention cost-share program had a very positive experience and nearly all indicated an interest in participating again. The vast majority of Wetlands Reserve Program (WRP) participants evaluated in Wisconsin indicated program satisfaction and an intention to maintain their projects (Forshay et al. 2005). In California, a majority of easement adopters agreed that the program was successful in farm preservation (Rilla 2002). In a separate study, although easement adopters had an overall positive experience, they encountered several restrictive issues regarding allowable property use (Rilla et al. 2000). Lastly, Wigginton (2009) evaluated several conservation cost-share programs in Mississippi and found high levels of satisfaction, with adoption goals of land stewardship, wildlife enhancement, and erosion control exceedingly met by most participants.

Literature evaluating conservation programs shows that buffer survival largely depends on livestock and wildlife predation, weed competition and maintenance regimes. Landowner retention of conservation practices, however, is influenced by a positive experience, limited maintenance concerns, achievement of adoption goals, and satisfaction with environmental services. This study evaluated landowner perceptions of land health impacts, maintenance effort, and negative financial impacts in relation to retention. Findings will help conservation agencies develop program enhancements that reduce negative buffer experiences and increase practice retention for years to come.

2.5 Conceptual Framework: UTAUT and Agroforestry Concepts

A conceptual framework of agroforestry adoption presented in Trozzo et al. (2014) includes the following predictors of interest: performance expectancy, effort expectancy, risk expectancy, social influence and facilitating conditions of resource endowments and market incentives. Hypothesized moderators include biophysical factors and preferences. Several

influential factors were found to affect interest in MCBs in Trozzo et al. (2014): social influence, risk expectancy, planting experience, performance expectancy and parcel size. This conceptual framework was used to guide research design to study the influence of performance expectancy, effort expectancy and social influence on landowner preferences for MCBs.

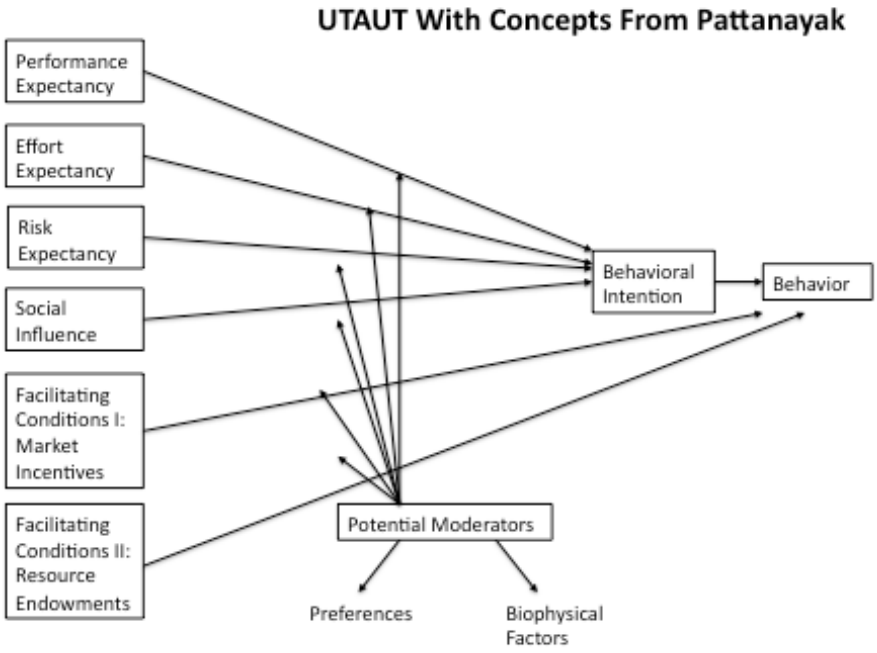

Figure 2.1. Combination of UTAUT and Agroforestry Adoption Model (Trozzo 2014).

Performance expectancy is a landowner's predicted performance of MCBs, such as crop yield and wildlife benefits. Effort expectancy is the expected workload required to establish, maintain, harvest a MCB and market associated products. Risk expectancy includes short-and long-term threats, such as market volatility, which can influence adoption and retention. Lastly, social influences represent impacts peers have on adoption and retention.

Facilitating conditions are perceived available assistance, such as market incentives and resource endowments, that also can affect adoption and retention (Venkatesh et al. 2003). Market incentives, such as income loss or gain and market accessibility, lower costs and/or increase benefits associated with adoption and retention. Resource endowments, such as labor and credit,

help enable buffer adoption and retention. Lastly, potential moderators include biophysical factors, or land characteristics such as erosion and parcel size, and preferences, or landowner characteristics such as age, education and income levels (Pattanayak et al. 2003).

2.6 Summary

In summary, conservation buffers are an agroforestry practice in which vegetated strips are strategically positioned within a landscape to enhance wildlife habitat and improve and protect water, air and soil quality. Despite these environmental benefits, adoption remains low. As a result, an increasing body of literature has been dedicated to identifying key factors that influence adoption, including landowner and land characteristics, social influences, and expected risks and benefits. Since much of this research focuses on landowners in general, buffer preferences among landowners with prior buffer experience are largely unknown. By targeting conservation buffer adopters in this research, study participants can tap into their experienced-based insight to indicate interest in and opinions of MCBs, including design and management preferences, and the impact of social influences and expected buffer performance and effort on practice appeal. Findings can help inform the development of MCB outreach and programming.

Despite the benefits, internal post-adoption evaluations of conservation buffer programs also remain infrequent. As a result, information about landowner satisfaction with and long-term retention of conservation buffers is limited. There are, however, several external evaluations that have identified key factors in buffer retention, including adoption goals, environmental services and maintenance concerns. This study contributes to retention literature by evaluating the influence a buffer's perceived land health impacts, maintenance effort, and negative financial impacts have on intentions to retain. Findings can help conservation agencies develop program enhancements that improve buffer experiences and retention.

CHAPTER 3: LANDOWNER EXPERIENCE WITH COST-SHARE CONSERVATION BUFFERS

3.1 Introduction

Conservation buffers are recommended as an agricultural BMP (Lowrance et al. 1995). To assist landowners in their implementation, state and federal conservation agencies provide cost-share support to offset buffer establishment costs. In most cases, landowners must sign a 2-15 year contract to receive support, the stipulations of which provide guidance on allowable buffer maintenance activities and uses. Some programs, like FSA's CREP, provide yearly rental and maintenance payments to buffer adopters (USDA FSA).

Despite cost-share programs and other incentives, buffer adoption rates are low. Furthermore, the permanence and maintenance of cost-share buffers that are adopted is largely unknown. Conservation agencies typically lack the funding needed to comprehensively evaluate projects (Kleiman et al. 2000), and more specifically, are limited to assessing only those under contract. Currently, many buffers are approaching their contract termination date and agencies are increasing their focus on re-enrollment and long-term retention. Given the loss of natural riparian forest buffers in the eastern U.S. and increasing water quality and quantity challenges, it is imperative to identify strategies for increasing the long-term retention of conservation buffers (Allen et al. 2001).

This study sought to evaluate landowner experiences with and perceptions of their conservation buffer and to determine how these perceptions relate to their intentions to retain the practice long-term. We surveyed landowners who have adopted a conservation buffer through FSA's CREP and CRP, and used the data to describe these experience-based respondents based on differences in their buffer perceptions, intentions to retain, land management objectives and

buffer adoption goals. We found that intentions to retain are highest among adopters who have non-monetary land management objectives, who perceive their buffer's land health impacts, and who experience limited negative financial impacts and maintenance struggles. Furthermore, we were interested in how these conservation buffer adopters compare to landowners outlined in adoption literature. Evaluation findings are expected to inform recommendations toward enhancing program effectiveness and efficiency for improved buffer experiences and increased practice retention.

3.2 Conservation Buffers

Promoted as an agricultural BMP by natural resource professionals, conservations buffers are defined as vegetated strips designed to protect and improve water, air and soil quality and enhance wildlife habitat. There are many different types of conservation buffers, including wildlife habitat and riparian buffers, each targeting a specific resource concern (Bentrup 2008). As an agroforestry practice, these buffers intentionally integrate and intensively manage trees and/or shrubs with crops and/or livestock (Gold and Garrett 2009).

Although the function and design of agroforestry practices has been studied in depth (Lowrance et. al 1984; 2000; Gold and Garrett 2009; Schoeneberger 2009; Jose 2012), far less is known about adoption preferences and practice retention, particularly in the United States. However, successful implementation and retention of agroforestry practices requires a scientific understanding of both agroforestry application *and* adoption preferences (Pattanayak et al. 2003).

3.3 Conservation Buffer Adoption

Adoption literature outlines numerous land and landowner characteristics that are thought to impact interest in adoption of conservation buffers. In this study, we explored how these

characteristics compare to those of CREP and CRP conservation buffer adopters. One of these influential characteristics includes farm size (Pattanayak et al. 2003; Strong and Jacobson 2005; Barbieri and Valdivia 2010; Trozzo et al. 2014). Napier et al. (2000) found that interest in BMPs is highest among large, high-income farms, while Trozzo et al. (2014) observed greater interest in buffers among small, high-income landowners. In between both, Armstrong and Stedman (2012) found no relationship between buffer adoption and parcel size.

Landowner characteristics have also been studied for their relationship to adoption. Socioeconomic traits, such as age (Hagan 1996; Strong and Jacobson 2005; Valdivia and Poulos 2009), education (Hagan 1996; Arbuckle et al. 2009), occupation (Buttel et al. 1981; Schrader 1995) and economic attributes (Featherstone and Goodwin 1993; Pattanayak et al. 2003; Raedeke et al. 2003) have been found to correlate in one way or another with adoption. Both Hagan (1996) and Valdivia and Poulos (2009) observed that younger landowners are more interested in conservation buffers, while Trozzo et al. (2014) found that age plays a limited role in multifunctional buffers. Similarly, Hagan (1996) found a positive relationship between higher education levels and buffer interest, while Armstrong and Stedman (2012) did not. Farming status may also play a role, as landowners who do not farm are typically more interested in agroforestry practices (Arbuckle et al. 2009; Trozzo et al. 2013; 2014). However, small-scale, part-time farmers are most interested in riparian buffers when compared to other agroforestry practices (Buttel et al. 1981; Schrader 1995; Primdahl 1999; Ryan et al. 2003).

Economic attributes, such as income, are reported as influential factors in agroforestry adoption by some (Featherstone and Goodwin 1993; Pattanayak et al. 2003), but not by others (Valdivia and Poulos 2009). Other extrinsic motivations, like cost-share payments, are not strongly associated with buffer adoption (Ryan et al. 2003). On the other hand, those with strong

intrinsic motivations, such as land preservation for future generations, are generally more interested in forest buffers (Matthews et al. 1993; Ryan et al. 2003; Valdivia and Poulos 2009), as are landowners who value environmental benefits (Strong and Jacobson 2005; Arbuckle et al. 2009) and recreation (Arbuckle et al. 2009; Barbieri and Valdivia 2010).

Lastly, expected consequences and benefits to adoption can influence interest. For example, concerns regarding buffer size, maintenance effort and land aesthetics can impair participation in buffer cost-share programs (Armstrong and Stedman 2012). Ryan (1998) reported that farmers find overgrown stream banks aesthetically messy and unappealing, and Carr and Tait (1991) noted that farmers would remove buffers in order to maintain an aesthetically pleasing farmscape. Furthermore, Ryan et al. (2003) found that woody plantings are less aesthetically appealing to farmers than grass buffers. Nevertheless, expected benefits of adoption, such as crop yield and environmental impacts, can positively affect adoption interest (Arbuckle et al. 2009; Valdivia and Poulos 2009; Trozzo et al. 2013; 2014).

3.4 Conservation Buffer Evaluation

Conservation agencies typically lack the funding required to comprehensively evaluate projects post-adoption. As such, landowner satisfaction with and retention of conservation buffers is largely unknown. However, periodic evaluations and implementation of its recommendations are essential for increased program effectiveness, efficiency and long-term success. It is recommended that these evaluations assess not only program achievements, but also the efficiency and effectiveness of the program's operation and performance. Despite the benefits, internal post-adoption evaluations of conservation buffer programs remain infrequent (Kleiman et al. 2000). There are, however, several notable external evaluations of conservation buffers depicted in the scientific literature.

Positive post-adoption experiences and outcomes are reported as influential factors in conservation buffer satisfaction and retention. Wigginton (2009) evaluated several conservation cost-share programs in Mississippi and found high levels of satisfaction among participants whose adoption goals of land stewardship, wildlife enhancement and erosion control were attained. Knipps (2011) evaluated the Landowner Incentive Program (LIP) in Texas and also found that most participants would re-enroll if their project goals had been achieved. Similarly, Rossi et al. (2010) found that most pine beetle prevention program participants with a very positive experience were also interested in re-enrollment. Lastly, program satisfaction was indicative of long-term maintenance intentions among the vast majority of Wetlands Reserve Program (WRP) participants evaluated in Wisconsin (Forshay et al. 2005).

Negative experiences with conservation buffers can also influence satisfaction. Among Conservation Reserve Program (CRP) participants, Vandever et al. (2002) discovered satisfaction with ecosystem services, such as soil retention and increased wildlife sightings, but dissatisfaction from those who perceived their conservation zones as a weed source. In California, although easement adopters had an overall positive experience, some were dissatisfied with several restrictive issues regarding allowable property use (Rilla et al. 2000).

This study contributes to retention literature by evaluating how a landowner's perception of their buffer's land health impacts, maintenance effort, and negative financial impacts influence intentions to retain. Distinct conservation buffer experiences are captured, each with unique differences in buffer perceptions and intentions to retain. Findings can help conservation agencies develop program enhancements that improve buffer experiences and retention.

3.5 Methods

Study Population

Two-hundred and sixty-seven Virginia landowners who have adopted a CREP or CRP conservation buffer through FSA were surveyed. Their names and contact information were gathered from a Freedom of Information Act (FOIA) request to FSA, and filtered to include only adopters of tree-based buffers. Their 10-15 year contracts require they plant open land with approved perennial plant species according to standardized conservation practices. Eligible landowners must own or operate their land for at least one year prior to the sign-up period. Furthermore, their land must either be agricultural commodity cropland for four of the six previous years or marginal pastureland (USDA FSA).

Survey Instrument

A survey instrument was developed based on retention factors identified in peer review literature. Interviews with key informants from NRCS, FSA, DOF and S&WCD were also used to gather insight regarding specific retention factors they had experienced professionally. The instrument was pretested using cognitive interviewing on six landowners with conservation buffers on their property (Beatty and Willis 2007). Results were used to refine the survey by gauging the suitability and reliability of individual questions and constructs (Willis 1999). Once revised, an expert review panel assessed the survey and final adjustments were made.

Participants were surveyed following Dillman's Tailored Design Method (Dillman et al. 2009). A pre-notification letter provided an overview of the study and requested participation in a questionnaire that would follow. One week later, a cover letter and questionnaire was mailed to participants. A reminder post card was mailed ten days later, followed by a replacement cover letter and survey three weeks later.

The survey included 5 questions intended to measure landowner perceptions of and intentions to retain their conservation buffer. Respondents were asked to check their top 3 most

important land management objectives and most influential reasons for adopting a conservation buffer from a discrete list (Tables 3.1, 3.2). If a respondent checked two or more monetary objectives, they were considered to focus more on monetary, rather than amenity, land management objectives and vice versa. Similarly, if they checked two or more programmatic factors, or those associated with cost-share programs, they were considered to adopt because of programmatic, rather than non-programmatic, incentives and vice versa. Lastly, 5-point *Likert*-type scales (1 = "not at all" to 5 = "extremely") were used to measure a landowner's intentions to retain their conservation buffer after contract termination, along with their overall buffer satisfaction, convictions about its effectiveness in improving land health, the difficulty faced maintaining it, and beliefs about its financial impacts.

Table 3.1. Monetary and non-monetary land management objectives.

Land Management Objectives	
Monetary Objectives	Non-monetary Objectives
Increasing my income	Improving my land's health
Producing agricultural goods	Passing my land onto heirs
Increasing my land's value	Enhancing beauty and scenery
Improving my land's productivity	Enhancing wildlife habitat

Table 3.2. Programmatic and non-programmatic conservation buffer adoption factors.

Conservation Buffer Adoption Factors	
Programmatic Factors	Non-programmatic Factors
Financial cost-share assistance	Improving my water quality
Increasing my CRP/CREP application score	Enhancing wildlife habitat
Yearly rental payments	Conserving soil

Land and landowner characteristics were also measured, including parcel size, land tenure, age, gender, education and income. Additionally, respondents indicated if they identify as a farmer, and if so, how much time they spend farming. Since late responders are similar to non-responders, we tested for non-response bias by comparing land and landowner characteristics

among early and late respondents and tested for significant differences using x^2 (after Groves et al. 2002). Late responders were classified as those who completed and returned a questionnaire after the final mailing was sent out.

Data Analysis

Frequencies were used to study respondent demographics and the characteristics of their land. Two-step cluster analysis, which allows for multivariate statistical clustering of data records, was conducted to group landowners into segments based on their beliefs about the effectiveness of their buffer in improving land health, buffer maintenance challenges, and associated financial impacts. The two-step procedure was chosen for its ability to automatically determine the optimal number of clusters, rather than manually estimating prior to analysis. Useful clusters were relatively evenly distributed and based on a good silhouette measure of cohesion and separation. Given the categorical nature of the data, a Kruskal-Wallis non-parametric statistical procedure and frequency tests were conducted to compare conservation buffer perceptions and intentions to retain across respondent clusters. Differences in the most important land management objectives and most influential conservation buffer adoption factors were also assessed for each cluster using frequency tests.

3.6 Results

Two-hundred and fifty-one surveys were successfully delivered and one-hundred and thirty-six were completed and returned for an adjusted response rate of 54.2%. In addition, no differences were observed between the land and landowner characteristics of early and late respondents, so the results are generalizable to the target population. Respondents were primarily 65 years or older and most were male (Table 3.3). More than half of respondents had college degrees at the Bachelors or Graduate level and predominantly made $50,000 to $150,000

annually. A vast majority of landowners considered themselves farmers, of which just over half worked full-time. On average, respondents owned their land for 32 years with an average parcel size of 263 acres.

Table 3.3. Land and landowner characteristics among survey respondents.

Socioeconomic Variables	All Respondents (n=135)
Age (years)	
25-44	9.3% (n= 12)
45-64	41.9% (n= 54)
65 or older	48.8% (n= 63)
Gender	
Male	79.5% (n= 105)
Female	20.5% (n= 27)
Education	
Some high school & high school degree	26.7% (n= 35)
Some college & associate degree	18.3% (n= 24)
Bachelors degree & graduate degree	55.0% (n= 72)
Income	
Less than $25,000-$50,000	28.8% (n= 34)
$50,000-$150,000	49.2% (n= 58)
$150,000-Over $200,000	22.0% (n= 26)
Farmer	
Yes	78.3% (n= 101)
No	21.7% (n= 28)
Time Spent Farming	
Full-time	51.0% (n= 49)
Part-time	28.1% (n= 27)
None (lease)	20.8% (n= 20)
Land Tenure	
Average ownership years	32 (n= 130)
Parcel Size	
Average acreage	263 (n= 131)

Two-step cluster analysis resulted in four landowner clusters grouped according to a good silhouette measure of cohesion and separation of 0.7 out of 1, indicating that respondents between clusters are adequately different and respondents within clusters are adequately related

(Table 3.4). Measures of central tendencies for buffer perceptions and intentions to retain were used to generate a descriptive title for each cluster. The four titles were *Discontented and Doubtful*, *Benefits with Burden*, *Contented and Confident*, and *Skeptical without Strife*. *Discontented and Doubtful* experienced some negative financial impacts and maintenance difficulties associated with their buffer, and were doubtful of associated land health impacts. Although *Benefits with Burden* were more likely to perceive the land health benefits of their buffer and less likely to notice negative financial impacts, they experienced burdensome maintenance. *Contented and Confident* were the most confident about their buffer's land health benefits, and least likely to perceive maintenance difficulties and negative financial impacts. Lastly, *Skeptical without Strife* was skeptical about the land health benefits of their buffer, but did not experience the strife associated with maintenance difficulties or negative financial impacts.

Table 3.4. Kruskal-Wallis and frequency results compare buffer perceptions and intentions across four landowner clusters.

Buffer Perceptions and Intentions	Discontented and Doubtful (n=29)	Benefits with Burden (n=28)	Contented and Confident (n=35)	Skeptical without Strife (n=32)	Sig.
	Rank Sum (Mode; Mean)				x^2; df; p-value
Land Health Impact	42.57 [a] (3; 2.86)	70.07 [b] (4; 3.68)	95.36 [c] (4; 4.23)	38.00 [a] (3; 3.00)	62.920; 3; .000*
Maintenance Effort	34.59 [a] (2; 2.76)	33.00 [a] (3; 3.00)	91.03 [b] (5; 4.51)	82.41 [b] (4; 4.28)	74.216; 3; .000*
Financial Impact	33.79 [a] (3; 3.48)	63.39 [b] (5; 4.54)	78.91 [b] (5; 4.83)	69.78 [b] (5; 4.66)	34.979; 3; .000*
Intentions to Retain	42.16 [a] (4; 3.14)	59.73 [a] (4; 3.75)	82.85 [b] (4; 4.38)	59.81 [a] (4; 3.81)	24.690; 3; .000*

* Significant at $\alpha = 0.05$; rank sums with the same letter are not significantly different according to Pairwise Comparisons. Silhouette measure of cohesion and separation= 0.7; predictor importance order= maintenance effort; land health impact; financial impact.

In general, perceptions and intentions to retain differed significantly across the four landowner clusters ($\alpha = 0.05$). Pairwise comparison using inter-variable separation of rank sum scores indicated that the greatest amount of variability across landowner clusters occurred in terms of perceived land health impacts followed by maintenance effort. *Discontented and Doubtful* were least likely to retain or have positive perceptions of their buffer, while *Contented*

and Confident were most likely. Although *Benefits with Burden* and *Skeptical without Strife* share similar intentions to retain their buffers, they differed with respect to their perceptions on maintenance effort and land health impacts.

Comparisons of preferentially checked land management objectives and factors influencing conservation buffer adoption depicted noticeable differences and similarities among the four landowner clusters (Figure 3.1, 3.2). Improving my land's health was the most important land management objective for all clusters, while the remaining two top objectives varied across clusters. Similarities in land management objectives between clusters occurred predominately with regard to increasing my income (range = 27.6% to 37.5%), while divergence occurred predominately with regard to increasing my land's value (range = 43.8% to 51.7%). *Discontented and Doubtful* was the only cluster to predominately hold monetary land management objectives.

Within clusters, *Discontented and Doubtful* found improving my land's health, improving my land's value and improving my land's productivity most important respectively. *Benefits with Burden* favored improving my land's health, passing my land onto heirs and enhancing wildlife habitat as their top three objectives. *Contented and Confident* preferred improving my land's health, followed by enhancing wildlife habitat and enhancing beauty and scenery as their most important objectives. Lastly, *Skeptical without Strife* perceived improving my land's health, enhancing wildlife habitat and increasing my land's value to be the most important land management objectives respectively.

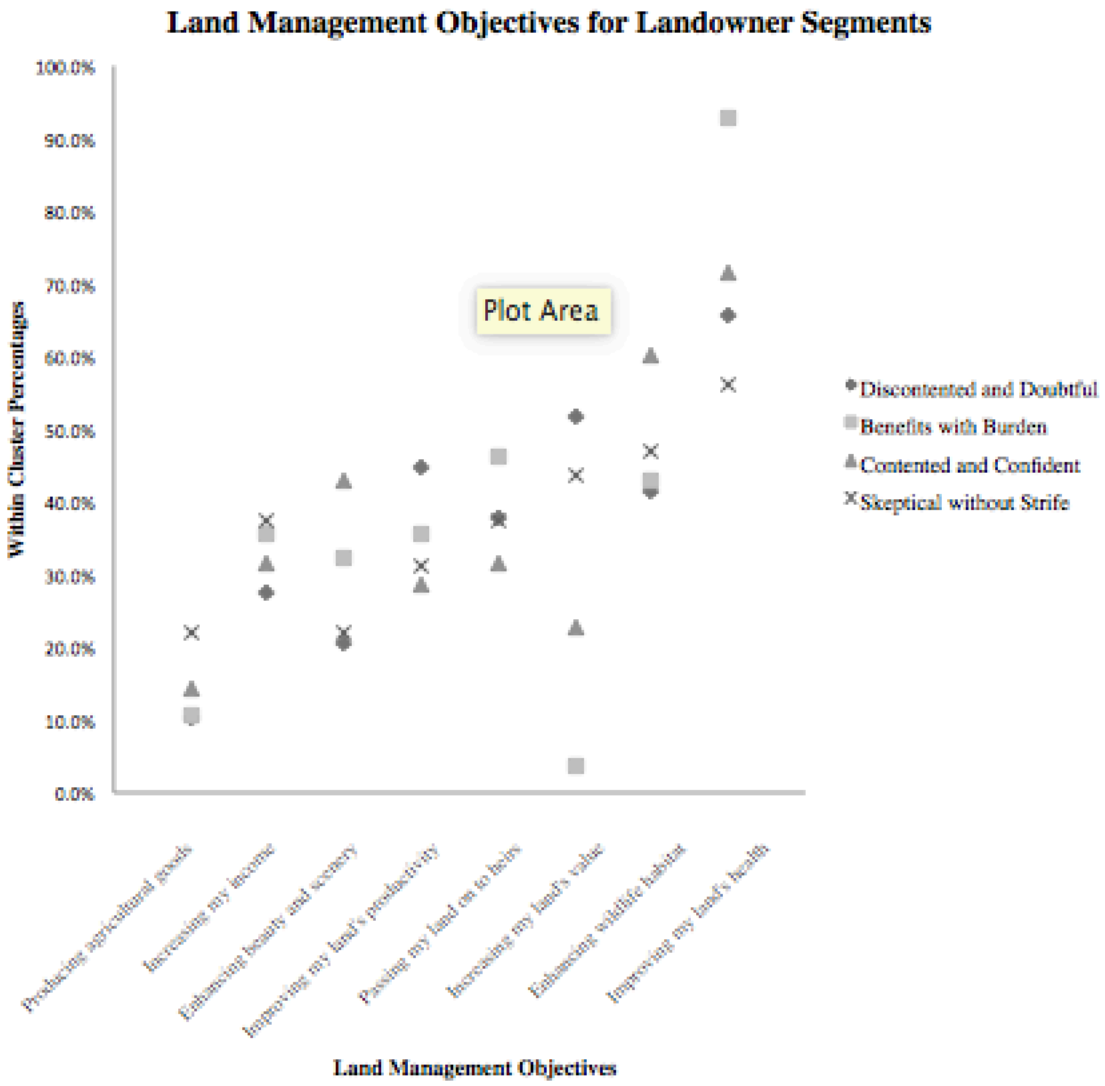

Figure 3.1. Percentages of important land management objectives across four landowner clusters.

The two most influential factors in conservation buffer adoption for all clusters included financial cost-share assistance and improving water quality. The third top factor varied between conserving soil and enhancing wildlife habitat. Similarities in the preferentially checked buffer adoption factors between the four landowner clusters occurred predominately with respect to improving water quality (range = 75.0% to 82.9%), while divergence occurred predominately in terms of yearly rental payments (range = 5.7% to 31.3%). Despite the influence of financial cost-share assistance, all clusters predominately checked non-programmatic adoption factors.

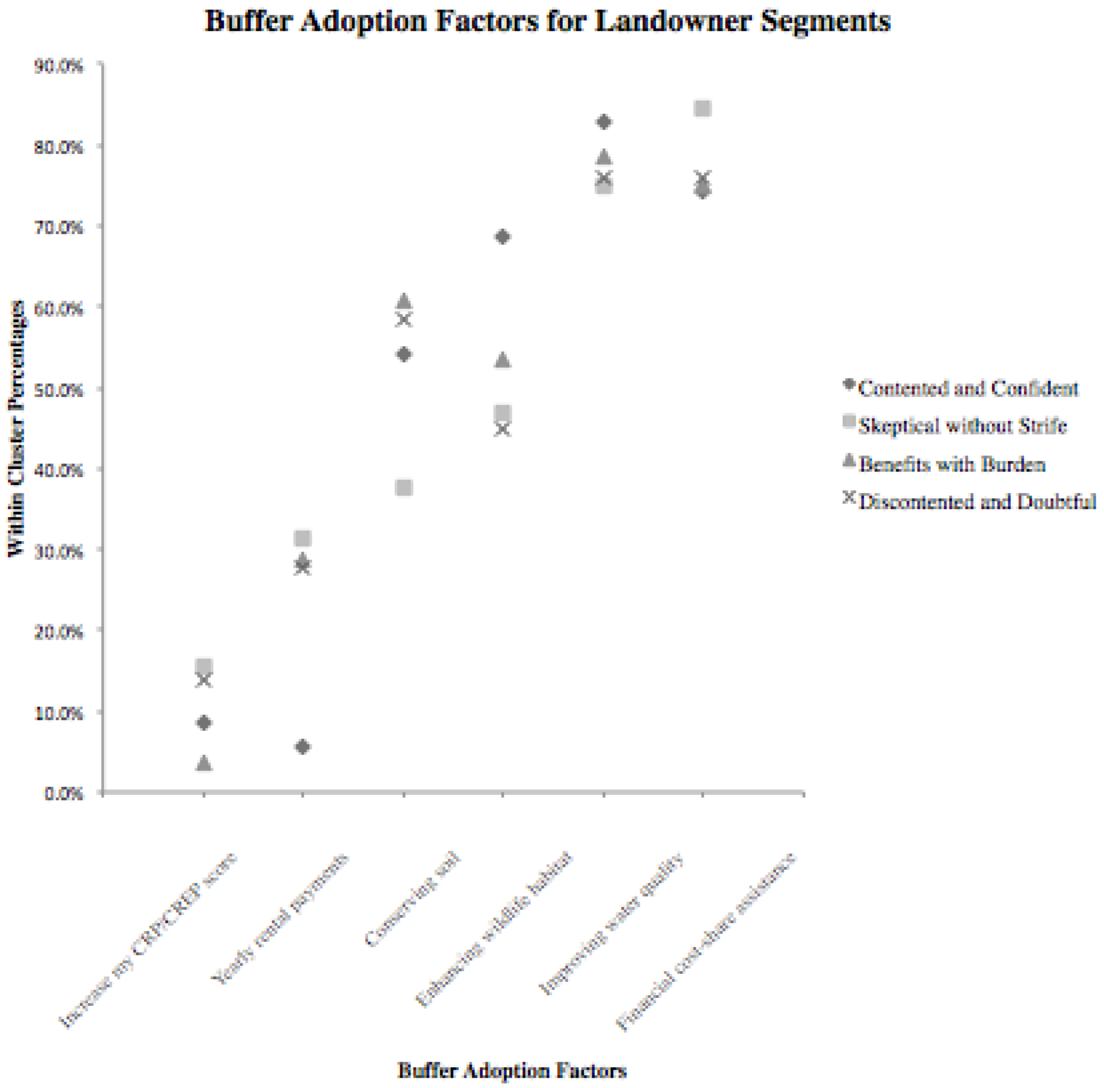

Figure 3.2. Percentages of influential conservation buffer adoption factors across four landowner segments

Within clusters, *Discontented and Doubtful* and *Benefits with Burden* both found financial cost-share assistance, improving water quality and conserving soil to be the most influential factors in conservation adoption respectively. *Contented and Confident* and *Skeptical without Strife* both perceived financial cost-share assistance, improving water quality and enhancing wildlife habitat to be the top three conservation buffer adoption factors.

3.7 Discussion

Conservation Buffer Adopters

Conservation buffer adopters surveyed in this study have both similar and dissimilar characteristics to those outlined in previous adoption literature. Respondent demographics indicate conservation buffer adopters are generally over the age of 65. This finding does not necessarily reflect notions in the literature that younger landowners are often more interested in adoption (e.g., Valdivia and Poulos 2009), though landowners in general tend to be older. More closely aligned with previous research were findings that most landowners were male (e.g., Strong and Jacobson 2005), and had high education levels (e.g., Arbuckle et al. 2009) and average incomes (e.g., Trozzo et al. 2013; 2014).

Previous studies suggest farmers tend to be less likely to adopt conservation practices (e.g., Barbieri and Valdivia 2010), particularly full-time farmers (Buttel et al. 1981; Schrader 1995; Primdahl 1999). This is likely because full-time farmers rely more heavily on available farmland for income than part-time farmers (Ryan et al. 2003). However, a majority of adopters in this study farm full-time, indicating full-time farmers should not necessarily be discounted. Adopters in this study also had relatively large parcels and long land tenures when compared to previous studies. This supports Featherstone and Goodwin's (1993) findings that large farms were more likely to invest in conservation, but contrasts the findings of Trozzo et al. (2013; 2014) where newer landowners with smaller parcel sizes expressed greater interests in multifunctional buffers.

Contented and Confident

Contented and Confident participants were most confident about the environmental benefits of their conservation buffers and have experienced the least financial burden and maintenance struggles post-adoption. Not surprisingly, they were most likely to report stronger

intentions to retain their buffers long-term. Findings are similar to studies where the most satisfied adopters of conservation practices were also pleased with associated environmental benefits (Vandever et al. 2002). Also expected from the literature, satisfied participants were likely to retain and maintain their practice long-term (Forshay et al. 2005; Rossi et al. 2010).

Another potential indicator of satisfaction are non-monetary land management objectives, including "improving my land's health," "enhancing wildlife habitat" and "enhancing beauty and scenery." Wigginton (2009) found that participants whose non-monetary adoption goals were achieved were more likely to be satisfied with their cost-share program. Furthermore, *Contented and Confident* participants found non-programmatic buffer adoption factors, such as "improving water quality" and "enhancing wildlife habitat," more influential than others. These results align with findings that landowners who have strong intrinsic motivations (Ryan et al. 2003; Valdivia and Poulos 2009) and value environmental benefits (Strong and Jacobson 2005; Arbuckle et al. 2009) are generally more interested in adopting conservation practices.

Although *Contented and Confident* participants are most easily satisfied, several steps could be taken to ensure retention of conservation buffers. Outreach strategies for this cluster should focus on non-monetary benefits of conservation buffers that align closely with amenity and environmental motivations and objectives (e.g., wildlife habitat and water quality improvement). To meet their land management objectives, conservation buffers should be designed with species that this group finds aesthetically pleasing and enhance habitat.

Discontented and Doubtful

By contrast, *Discontented and Doubtful* were least confident about the benefits of conservation buffers and have experienced the most financial burden and maintenance struggles post-adoption. This group is the least likely to retain their buffer long-term. Findings are similar

to studies where the most dissatisfied adopters of conservation practices reported maintenance challenges (Vandever et al. 2002) and considered their buffer restrictive to development projects that could enhance land value (Rilla et al. 2000). As expected, such unsatisfied participants are much less likely to retain and maintain their buffer long-term (Forshay et al. 2005; Rossi et al. 2010).

Discontented and Doubtful were the only cluster inclined to find monetary land management objectives, such as "increasing my land's value" and "improving my land's productivity," more influential than other landowner types. Matthews et al. (1993) found similar results, in which economics played a major role in agroforestry adoption. However, results differ from the findings of Ryan et al. (2003) and Arbuckle et al. (2003) where farmers were less likely to adopt conservation practices if they held monetary land management objectives. These results suggest that conservation adopters can indeed hold monetary land management objectives, but that those with stronger monetary aims will generally only adopt conservation practices that match their production goals (Ryan et al. 2003). Adopters in this cluster may have found conservation buffers complementary to their land use goals, but also struggle to achieve a useful balance.

Although programmatic "financial cost-share assistance" was influential in *Discontented and Doubtful's* decision to adopt, the non-programmatic factor of "improving water quality" was equally important, with "conserving soil" close behind. These results counter findings in which extrinsic motivations, like cost-share payments, are not influential to interest in buffer adoption (Ryan et al. 2003). They are, however, complementary to findings in which intrinsic motivations and amenity values relate to interest in agroforestry (Ryan et al. 2003; Strong and Jacobson 2005; Arbuckle et al. 2009; Valdivia and Poulos 2009).

Since *Discontented and Doubtful* participants were the least satisfied with their conservation buffer, several steps should be taken to ensure retention of the practice. Outreach efforts should primarily focus on monetary opportunities, such as buffers that benefit from financial cost-share assistance and are designed to improve land value. These efforts should be supplemented with information about the environmental benefits that are important to this group, including improving water quality and conserving soil. Since maintenance effort is also a concern, supplementing program benefits with increased yearly maintenance payments could help reduce perceptions of negative financial impacts. Lastly, to reduce the amount of maintenance required, conservation buffers should be designed with fast growing, adaptive and resilient species that outcompete weeds and pests.

Benefits with Burden

In the between both *Contented and Confident* and *Discontented and Doubtful* with respect to their intentions to retain, lie *Benefits with Burden* and *Skeptical without Strife*. Although more likely to perceive land health impacts and less likely to experience negative financial impacts associated with their buffer, *Benefits with Burden* participants believe maintenance is more difficult than most. This result is similar to studies where adopters of conservation practices became dissatisfied when faced with weed maintenance concerns, while at the same time seeing the environmental benefits of their buffers (Vandever et al. 2002). As expected, these generally satisfied participants are likely to retain and maintain their buffer long-term (Forshay et al. 2005; Rossi et al. 2010).

This cluster also finds non-monetary land management objectives, including "improving my land's health" and "passing my land on to heirs," to be more influential than other clusters. On the other hand, they perceive monetary objectives, like "increasing my land's value," to be

far less important than other landowner types. Often, satisfied cost-share program participants have non-monetary adoption goals that were attained (Wigginton 2009).

Adoption preferences for *Benefits with Burden* were similar to *Contented and Confident*. Although programmatic "financial cost-share assistance" was influential in their decision to adopt, the non-programmatic factor of "improving water quality" was ranked highest, with "conserving soil" trailing closely. Results complement findings in which intrinsic motivations and amenity values are strongly associated with interest (Ryan et al. 2003; Strong and Jacobson 2005; Arbuckle et al. 2009; Valdivia and Poulos 2009).

Although *Benefits with Burden* were likely to retain their buffer, several measures can be taken to improve their overall experience. Non-monetary benefits of conservation buffers that are important to this group, such as improving water quality and conserving soil, should be promoted. The availability of financial cost-share assistance should also be promoted to continue this cluster's financial satisfaction with their buffer. Finally, designing buffers with vigorous and hardy species can alleviate maintenance concerns.

Skeptical without Strife

Although buffer maintenance is perceived generally as less difficult and negative financial impacts limited, *Skeptical without Strife* participants were less likely to report observing any impacts to land health associated with their conservation buffer. Vandever et al. (2002) found that the most satisfied adopters of conservation practices were able to see and also pleased with environmental benefits. As a result, it is not surprising that *Skeptical without Strife* participants are slightly less satisfied and less inclined to retain their buffer when compared to *Contented and Confident*. Limited maintenance concerns and financial burdens, however,

suggest this is a generally satisfied buffer own type, and satisfaction is indicative of long-term retention (Forshay et al. 2005; Rossi et al. 2010).

The most important non-monetary land management objectives to *Skeptical without Strife* participants include "improving my land's health" and "enhancing wildlife habitat." The monetary objective of "increasing my land's value" trailed behind. Arbuckle et al. (2003) found that farmers were more likely to adopt conservation practices if they held non-monetary land management objectives. Yet this result contends that adopters can hold both monetary and non-monetary objectives, particularly if these objectives meet their land use goals (Ryan et al. 2003).

The programmatic adoption factor of "financial cost-share assistance" was more influential to *Skeptical without Strife* than any other type. However, *Skeptical without Strife* participants are still grouped into the non-programmatic category with "improving water quality" and "enhancing wildlife habitat" closely following in importance. Results complement findings in which intrinsic motivations and amenity values are strongly associated with adoption interest (Ryan et al. 2003; Strong and Jacobson 2005; Arbuckle et al. 2009; Valdivia and Poulos 2009), but further suggest that extrinsic motivations can also play an important role (Matthews et al. 1993).

Although *Skeptical without Strife* are still generally likely to retain their buffer, steps can be taken to improve their overall buffer experience. Outreach for this cluster should primarily focus on non-monetary environmental benefits of conservation buffers, including improving land health and enhancing wildlife habitat. This can help reduce skepticism surrounding buffer impacts, while aligning these benefits with land management objectives. Lastly, the availability of financial cost-share assistance and buffer benefits to land value should be promoted.

3.8 Conclusion

This study identified four segments of owners that capture a range of experiences with conservation buffers. Those who were most likely to retain their buffer perceived greater land health benefits and experienced fewer negative financial impacts and maintenance struggles. The greatest amount of variability across landowner segments occurred with respect to perceived land health impacts followed by maintenance effort. However, all types were similar in their two most influential conservation buffer adoption factors – financial cost-share assistance and improving water quality – and their most important land management objective – improving my land's health.

Study findings suggest that while both intrinsic and extrinsic motivations can influence adoption of conservation buffers, intrinsic motivations and amenity values may be more important antecedents to buffer satisfaction and long-term retention. To improve buffer retention, findings indicate that conservation buffer programs should take proactive steps to reduce negative financial impacts and maintenance effort. This can include, for example, an increase in yearly maintenance payments to offset costs and a buffer design that includes adaptive and resilient species that require less upkeep. In addition, adopters are generally more inclined to retain a practice if it meets their initial adoption goals and expected environmental outcomes (Vandever et al. 2002). As a result, buffer designs and promoted benefits should align with the goals and objectives of adopters for the best chance of retention.

By providing conservation agencies with insight into the perceptions their cost-share program participants have of conservation buffers, they can more effectively reduce negative buffer experiences and increase long-term retention. To additionally manage experiences, supplemental research is suggested to more specifically identify which types of maintenance and financial concerns most strongly influence retention.

CHAPTER 4: LANDOWNER INTEREST IN AND PREFERENCES FOR MULTIFUCTIONAL CONSERVATION BUFFERS

4.1 Introduction

Conservations buffers are strategically placed vegetated strips that provide numerous ecosystem services, including the enhancement of wildlife habitat and water, air and soil quality (Bentrup 2008). As a result, conservation buffers are promoted as a BMP and establishment costs are offset under conservation cost-share programs, like FSA's CREP and CRP (Lowrance et al. 1995). Despite the benefits and incentives, adoption rates remain low. Typical buffer design often takes arable land out of production, making conservation and production mutually exclusive endeavors in buffer zones.

By incorporating productive NTFPs into a MCB, however, edible and ornamental crops can be harvested for profit or home use, while retaining key environmental services (Robles-Diaz-de-Leon 1998, Robles-Diaz-de-Leon and Nava-Tudela 1998). Economic analyses of MCBs indicate promising profit potential for landowners (Robles-Diaz-De-Leon and Tudela 1998). By merging conservation and production, MCBs have been shown to stimulate landowner interest in adoption (Trozzo et al. 2013; 2014). However, before MCB programming can be developed more information is needed about the opinions and preferences landowners have for MCBs, particularly among those with prior buffer experience.

With a multifunctional approach in mind, this study sought to identify the reasons landowners with conservation buffers are more or less interested in MCBs. In this regard, factors influencing MCB adoption and preferences for design and management options were also of interest. By tailoring research to landowners with conservation buffers, the role that MCBs could play in improving adoption of cost-share conservation plantings will be better understood.

Findings will provide conservation agencies with a better understanding of how adopting landowners view MCBs and why. This will help inform future outreach and technical support programming aimed at merging conservation and production in buffer zones.

4.2 Conservation Buffer Adoption

Peer review literature outlines numerous factors that influence adoption of conservation practices. Landowners with strong intrinsic motivations, such as soil conservation or preserving land for heirs, are generally more interested in adoption (Ryan et al. 2003; Strong and Jacobson 2005; Arbuckle et al. 2009). Those who value land stewardship are also more likely to adopt, despite additional labor and cost (Matthews et al. 1993). On the other hand, extrinsic motivations like resource endowments and crop yield have also been linked to adoption interest (Pattanayak et al. 2003; Trozzo et al. 2014). Matthews et al. (1993) discovered a similar association between economic incentives and adoption, but Ryan et al. (2003) noted that cost-share payments are not strongly correlated.

Perceived impacts on land aesthetics are also linked to adoption of conservation buffers (Ryan et al. 2003; Valdivia and Poulos 2009). Many farmers have a stronger preference for grass buffers compared to woody plantings (Ryan et al. 2003) and find overgrown buffers aesthetically displeasing (Ryan 1998). So much so, that some farmers indicate an intention to remove buffers in order to maintain land aesthetics (Carr and Tait 1991), while others are disinterested in participating in buffer cost-share programs altogether (Armstrong and Stedman 2012).

Social influences may also be linked to conservation adoption (Pattanayak et al. 2003; Armstrong and Stedman 2012; Trozzo et al. 2014). Armstrong and Stedman (2012) found that producers are more likely than non-producers to adopt buffers if a friend has already done so.

Moreover, Trozzo et al. (2014) observed that the opinions of family members and neighbors impact decisions to adopt, while Raedeke et al. (2003) noted the influence of family support.

Lastly, prior experience with and knowledge of conservation practices have also been studied for their influence on adoption. Armstrong and Stedman (2012) reported that knowledge of the practice does not appear to influence interest in buffer adoption, while Valdivia and Poulos (2009) found that it does. Furthermore, Ryan et al. (2003) reported that farmers who have prior experience with conservation practices are generally more likely to adopt agroforestry practices.

Much of the adoption research, however, focuses on landowners in general and fails to capture perspectives from landowners with prior buffer experience. By targeting conservation buffer adopters, this study ensures that participants are able to tap into experienced-based insight to indicate opinions of and preferences for MCBs, a relatively new and unfamiliar practice. As a result, this study contributes an experience-based perspective to conservation adoption literature by shedding light on MCB design and management preferences and practice appeal. Findings can inform future MCB outreach and programming aimed at increasing adoption of the practice.

4.3 Conceptual Framework: UTAUT and Agroforestry Concepts

A conceptual framework of agroforestry adoption presented in Trozzo et al. (2014) includes the following predictors of interest: performance expectancy, effort expectancy, risk expectancy, social influence, facilitating conditions of resource endowments and market incentives, and biophysical and preferences moderators. Several influential factors were found to affect interest in MCBs in Trozzo et al. (2014): social influence, risk expectancy, planting experience, performance expectancy and parcel size.

With this conceptual framework in mind, this study focused on the influence of performance expectancy, effort expectancy and social influence on preferences for MCBs.

Performance expectancy is a landowner's predicted performance of MCBs, such as crop yield and wildlife benefits. Effort expectancy is the expected workload required to establish, maintain, harvest a MCB and market associated products. Social influences represent impacts peers have on adoption and retention (Pattanayak et al. 2003).

4.4 Methods

Study Population

Two-hundred and sixty seven landowners who have adopted a CREP or CRP conservation buffer throughout Virginia were surveyed. Their names and contact information were obtained from an FOIA request to the FSA. These landowners signed a 10-15 year contract with FSA, agreeing to replace agricultural cropland with approved plant species and conservation practices. To be eligible, participants must own or operate their land for at least one year before applying, and their land must either be marginal pastureland or agricultural commodity cropland for four of the six years prior (USDA FSA). Although CREP and CRP offer numerous conservation practices, landowners in this study include only adopters of tree-based conservation buffers. This ensures survey participants have prior knowledge of and experience with conservation buffers, and can use this familiarity to answer hypothetical questions about MCBs.

Survey Instrument

Conservation buffer adoption literature was used to develop the survey instrument. The questionnaire was pretested and enhanced using cognitive interviewing with six landowners who have conservation buffers on their property (Beatty and Willis 2007). An expert review panel assessed the survey for final adjustments. The questionnaire was administered using Dillman's Tailored Design Method (Dillman et al. 2009). An overview of the study and a participation

request for an upcoming questionnaire was outlined in a pre-notification letter. One week later, the cover letter and questionnaire was mailed to participants, followed by a reminder post card approximately ten days later. A replacement cover letter and survey was mailed three weeks later.

The final survey included 9 questions intended to gauge landowner's interest in and preferences for MCBs. We measured baseline interest in MCBs on a 5-point *Likert*-type scale (1= "not at all" to 5= "extremely"). We then measured the effects of hypothesized establishment outcomes on a 5-point scale (1= "not at all" to 5= "a lot") to gauge how baseline interest shifts as more information is presented (Table 4.1). In a binary question, respondents were also asked if MCBs with fruit, nut and floral trees and shrubs are more appealing than those with traditional trees (e.g. pine, oak).

Table 4.1. Outcomes hypothesized to influence interest in MCBs (adapted from Trozzo et al. 2014).

Survey Question	MCB Establishment Outcomes
If the following outcomes were true, how much would each increase your interest in using fruit, nut and floral trees and shrubs in a buffer planting?	You get 75% of the planting paid for by the government You make money selling food and flowers You supply your friends and family with food and flowers You improve water quality in the region You improve wildlife habitat on your land You enhance beauty and scenery on your land You decrease soil loss on your land

Several interest constructs from a conceptual framework used in Trozzo et al. (2013) were used to develop matrix-style *Likert*-type questions that assess landowner opinions of MCBs (Table 4.2). PE was measured on a 5-point scale (1 = "extremely unlikely" to 5= "extremely likely"). EE was measured using a 5-point scale (1 = "no effort" to 5 = "a lot of effort"). SI was measured using a 5-point scale of agreement (1 = "strongly disagree" to 5 = "strongly agree").

Table 4.2. Interest constructs tested to gauge landowner opinions of MCBs (adapted from Trozzo et al. 2013).

Survey Questions	Measures	Constructs
How likely do you think the following outcomes would be if you planted a buffer with fruit, nut and floral trees and shrubs?	Most of the trees would survive The trees that live would grow lots of food and flowers Water quality would significantly improve The trees would make my land look sloppy The amount of wildlife would dramatically increase	Performance Expectancy (PE)
How much effort do you think each of the following steps would take to establish and maintain a buffer planted with fruit, nut and floral trees and shrubs?	Planning for the buffer planting Planting the buffer Managing the planted trees and shrubs Harvesting the fruits, nut and flowers Marketing the fruits, nuts and flowers	Effort Expectancy (EE)
What is your level of agreement with the following statements about buffer plantings with fruit, nut and floral trees and shrubs on your land?	Natural resource professionals will strongly favor these plantings Fellow landowners will think it is a good idea Close friends and family will think it is a good idea	Social Influence (SI)

Respondents were also asked to rank their MCB design and management preferences from a discrete list. Design options included several different categories of native edible and ornamental species, such as trees and shrubs with nuts or woody cut florals. Management options involved varying levels of maintenance, harvest and market efforts, from managing buffer products for farmer's market sales to letting trees and shrubs grow naturally.

Before asking questions regarding MCBs, several native NTFPs were listed as a definitional reference. Nut producing trees and shrubs included: American hazelnut (*Corylus americana)*, black walnut (*Juglans nigra*), and hickory (*Carya ovata*). Fruit producing trees and shrubs included: blueberry (*Vaccinium corymbosum*), elderberry (*Sambucus canadensis)*, black raspberry (*Rubus occidentalis*), blackberry (*Rubus alleganensis*), pawpaw (*Asimina triloba)*, American persimmon (*Diospyros americana)* and American plum (*Prunus americana)*. Lastly,

decorative woody cut florals included: hydrangea (Hydrangea arborescens), pussy willow (*Salix discolor*) and redosier dogwood (*Cornus sericea*).

Lastly, biophysical and demographic data was collected, including parcel size, land tenure, age, gender, education and income. Additionally, respondents specified if they consider themselves a farmer, and if so, the amount of time they spend farming and the type of farm products they produce. Non-response bias was investigated using x^2 to test for significant differences in these characteristics across early and late respondents, as late respondents are similar to non-respondents (after Groves et al. 2002). Late respondents were identified as those who completed and returned a questionnaire after the final mailing.

Data Analysis

Cronbach's alpha, a measure of construct reliability, was used to determine the internal consistency between the multi-item measures for each MCB interest construct. As alpha values increase closer to 1, random error decreases and the inter-relatedness between measures increase. As a result, only multi-item measures with high alpha values were summed and averaged to create summated independent variables PE, EE, and SI. Independent samples t-test was conducted to determine if these variables differ significantly across the binary appeal of MCBs. In a separate analysis, frequencies were used to study respondents' baseline interest in MCBs. A Friedman non-parametric statistical test and pairwise comparison were then conducted to rank several possible MCB outcomes by order of their influence on this baseline interest. Lastly, frequencies were used to study respondents' ranked preferences for MCB design and management options.

4.5 Results

Out of 251 successfully delivered questionnaires, 136 were completed and returned for an adjusted response rate of 54.2%. Furthermore, no significant differences were observed between the land and landowner characteristics of early and late respondents, so the results can be generalized to the target population. Multi-item measures of PE, EE and SI resulted in cronbach's alpha values close to 1, indicating consistent reliability among measures and a low error variance. Independent samples t-test results revealed significant mean differences for PE and SI, but not EE, when compared to respondents' opinions of MCB appeal (Table 4.3). Results suggest that landowners who find MCBs more appealing than buffers with traditional trees, are also more likely to have supportive peers and expect higher levels of performance associated with MCB adoption.

Table 4.3. T-Test results compare MCB interest factored by whether the respondent finds MCBs appealing.

		MCB Appeal									
		Yes (n= 76)			No (n= 55)						
Interest Constructs	α	n	μ	SD	n	μ	SD	t	df	sig.	95% CI
Performance Expectancy	.738	70	3.65	.544	51	3.14	.750	4.156	119	.000*	.280-.746
Effort Expectancy	.802	73	3.53	.694	51	3.80	.822	-1.914	122	.058	-.533-.009
Social Influence	.732	73	3.54	.574	51	3.10	.681	3.837	122	.000*	.210-.658

*Significant at α = .05; α = cronbach's alpha; μ = mean; SD = standard deviation; CI = confidence interval

On average, respondents were somewhat to very interested in MCBs (Table 4.4). Several potential outcomes of planting a MCB influenced the baseline interest (Table 4.5). Decreasing soil loss and improving wildlife habitat were most influential MCB outcomes on increasing interest, while supplying friends and family with and making money selling food and flowers were the least. Although pairwise comparison of MCB outcomes identified significant distribution differences with supplying friends with food and flowers and making money selling food and flowers, a high cronbach's alpha value indicated good internal consistency between all outcome measures.

Table 4.4. Respondents' baseline interest level in MCBs.

μ	SD	Not at all	Slightly	Somewhat	Very	Extremely
3.26	1.334	15.2%	12.1%	25.8%	25.8%	21.2%

μ = mean; SD = standard deviation

Table 4.5. Frequency and Friedman test results indicate ranked influence of MCB outcomes on interest.

MCB Outcomes (ranked by order of influence on interest)	μ	SD	μ rank	*How much would each outcome increase your interest?*				
				Not at all	A little	Somewhat	Quite a bit	A lot
Decrease soil loss	4.02	1.131	4.95 ^{bcde}	4.9%	4.1%	21.1%	24.4%	45.5%
Improve wildlife habitat	3.99	1.102	4.85 ^{bcde}	3.1%	7.9%	18.1%	28.3%	42.5%
Improve water quality	3.95	1.113	4.74 ^{bcd}	5.6%	4.0%	18.4%	33.6%	38.4%
Enhance beauty and scenery	3.78	1.209	4.41 ^{bc}	6.4%	9.6%	18.4%	30.4%	35.2%
75% paid for by the government	3.63	1.334	4.22 ^{b}	11.7%	10.2%	13.3%	33.6%	31.3%
Supply friends with food/flowers	2.70	1.257	2.64 ^{a}	23.2%	20.0%	28.0%	20.8%	8.0%
Make money selling food/flowers	2.19	1.298	2.19 ^{a}	40.3%	27.4%	12.9%	11.3%	8.1%
MCB outcome scale (α= .888)	3.45	0.936	-	-	-	-	-	-

μ = mean; SD = standard deviation; α = cronbach's alpha

Rank sums with the same letter are not significantly different at α = .05 according to Pairwise Comparison.

In regard to MCB design preferences, respondents were most partial to trees with nuts and least partial to brambles with berries (Table 4.6). Trees with fruit were the second most preferred species type, shrubs with nuts were third, woody cut florals were fourth, and shrubs with berries were tied between fourth and fifth. In regard to MCB management preferences, a majority of respondents were most partial to letting their buffer grow naturally and least partial to leasing their buffer zone to another farmer to manage (Table 4.7). Harvesting buffer products for home use or to share with peers was the second most preferred management type, while selling buffer products at farmer's markets was third, and establishing a u-pick in the buffer zone was fourth.

Table 4.6. MCB design preferences among respondents.

Species	1 (most preferred)	2	3	4	5	6 (least preferred)
Trees with nuts	**41.9%**	14.0%	15.1%	11.8%	10.8%	6.5%
Shrubs with nuts	4.3%	22.3%	**33.0%**	24.5%	10.6%	5.3%
Woody cut florals	7.4%	2.1%	5.3%	**27.7%**	23.4%	34.0%
Trees with fruit	23.7%	**30.1%**	19.4%	7.5%	14.0%	5.4%
Shrubs with berries	16.1%	21.5%	16.1%	**22.6%**	**22.6%**	1.1%
Brambles with berries	8.6%	9.7%	10.8%	5.4%	18.3%	**47.3%**

Bolded percentages signify the ranking the greatest number of respondents indicated for each specie option.

Table 4.7. MCB management preferences among respondents.

Management Scenarios	1 (most preferred)	2	3	4	5 (least preferred)
Lease	13.0%	7.6%	16.3%	13.0%	**50.0%**
U-pick	2.2%	5.4%	16.3%	**54.3%**	21.7%
Farmer's market	6.5%	12.0%	**38.0%**	19.6%	23.9%
Home use	30.4%	**48.9%**	15.2%	5.4%	0.0%
Grow naturally	**47.8%**	26.1%	14.1%	7.6%	4.3%

Bolded percentages signify the ranking the greatest number of respondents indicated for each management option.

4.6 Discussion

Interest and Appeal

Results indicated that only slightly more conservation buffer adopters find MCBs more appealing than those with traditional conservation trees, particularly when they are surrounded by supportive peers and anticipate greater buffer performance. On the other hand, anticipated effort involved in establishing and managing MCBs did not strongly influence appeal. Findings complement those of Trozzo et al. (2013; 2014), in which PE and SI helped predict intentions to adopt MCBs, but EE did not.

The insignificance of EE may be explained by analyzing the costs and benefits of adoption. If the benefits outweigh the costs of conservation, landowners are often more likely to adopt (Pattanayak et al. 2003). In support, Matthews et al. (1993) found that landowners who prioritized land stewardship benefits of conservation were more likely to adopt, despite the

increased cost and labor involved. In weighing the costs and benefits, respondents may have determined the anticipated performance of MCBs and peer support to be greater than the effort associated with establishment and management.

The positive correlation between PE and MCB appeal complement studies in which respondents showed higher levels of interest if they perceived buffers to be aesthetically pleasing (Kenwick et al. 2008), productive (Trozzo et al. 2014) and beneficial to the environment (Ryan et al. 2003; Strong and Jacobson 2005). In addition, the significant effect SI has on MCB appeal is similar to other studies in which neighborhood approval (Armstrong and Stedman 2012) and family support (Raedeke et al. 2003) influence adoption of conservation practices. Results suggest that landowners are likely to find MCBs more appealing if they anticipate high levels of performance from their buffer and are surrounded by family, friends and natural resource professionals who are supportive of the idea.

The conservation buffer adopters surveyed in this study were also somewhat to very likely interested in MCBs. This is similar to the findings of Trozzo et al. (2014), in which riparian forest buffer adopters were likely to adopt again, particularly with multifunctional species. Similarly, farmers who have adopted conservation practices in the past, are often more likely to establish riparian forest buffers in the future. This is expected, as prior knowledge of and experience with conservation practices is indicative of future adoption (Ryan et al. 2003; Valdivia and Poulos 2009). This result suggests that conservation buffer adopters are willing to expand existing plantings. With more and more landowners requesting agroforestry demonstrations in the southeastern U.S. (Workman et al. 2003), these existing adopters may be a good starting point for natural resource professionals looking to establish MCB demonstration plantings for new potential program participants.

Several potential outcomes of planting a MCB were influential in respondents' interest in the practice, including decreasing soil loss and improving wildlife habitat and water quality. This is expected, as landowners who value land stewardship (Matthews et al. 1993) and environmental benefits (Ryan et al. 2003; Strong and Jacobson 2005; Arbuckle et al. 2009) generally have greater interest in conservation. As such, ecosystem services of MCBs should be promoted as a recruitment strategy.

By contrast, supplying friends with food and flowers and making money selling food and flowers were least influential in MCB interest. This result is surprising, as it contends findings in which economic incentives (Matthews et al. 1993) and production-based outcomes (Robles-Diaz-de-Leon 1998; Trozzo et al. 2013; 2014) increase landowner interest in conservation. Taking a closer look at the frequencies for the multi-item measures of MCB interest constructs, we find that most respondents think MCBs are only "somewhat" likely to grow lots of food and flowers. Moreover, only approximately 10% of respondents "strongly agree" that the government or themselves have the know-how to carry out a MCB planting. In general, landowners are less likely to adopt practices they are unfamiliar with (Matthews et al. 1993). Of the 78% of respondents who considered themselves a farmer, only 2% were growing fruits and nuts and 1% were producing flowers. So although respondents have adopted a conservation buffer in the past, harvesting and/or marketing food and flowers from a MCB may be a relatively new concept that involves a greater level of uncertainty. Pattanayak et al. (2003) noted that such risk and uncertainty decreases adoption interest, while receiving training in conservation practices increases the likelihood of adoption. These results suggest that potential adopters may find MCBs, and their production-based outcomes, more appealing if they receive training that decreases risk and uncertainty associated with the practice.

In addition to risk and uncertainty, most respondents think harvesting and marketing requires "quite a bit of effort" and they only "somewhat" believe there's a reliable market for buffer products. At the same time, Pattanayak et al. (2003) documented a trend in agroforestry adoption literature in which labor availability and a shorter distance to market correlated positively with adoption. The effort involved in harvesting and marketing requires a significant amount of labor and easy accessibility to reliable markets, which may seem unobtainable to most respondents. MCBs intended for harvest and market may then be better suited to landowners with more labor and time availability and live close to established markets.

Design and Management Preferences

Respectively, respondents had the highest preference for trees with nuts and fruit, and the lowest preference for brambles and shrubs with berries. This is not surprising given the land aesthetic preferences outlined in previous studies. Many farmers find overgrown woody buffers aesthetically displeasing (Ryan 1998), preferring instead to have a well-manicured grass buffer (Ryan et al. 2003). Brambles and shrubs with berries may be perceived as weedy perennials that easily spread, both within and outside the buffer zone, creating an untidy and unattractive landscape. Vandever et al. (2002) reported similar results among CRP participants who grew dissatisfied with their conservation buffer if it became a weed source. In fact, Armstrong and Stedman (2012) found that landowners facing aesthetic and maintenance concerns became disinterested in participating in buffer cost-share programs altogether. As such, MCB designs should promote the use of aesthetically pleasing and non-invasive native trees with nuts or fruit.

Respondents also held distinctive preferences for MCB management options, with the highest preference for letting buffers grow naturally. Kenwick et al. (2008) and Armstrong and Stedman (2012) found maintenance to be an unappealing aspect of riparian buffers, so it is not

surprising that management options requiring less maintenance were preferred. Harvesting buffer products for home use or farmer's market sales were ranked second and third among management options. This result suggests that conservation buffer programs should not only allow for natural buffer growth, but also occasional harvest of buffer products for home use or sale to entice adoption (Robles-Diaz-de-Leon 1998; Trozzo et al. 2014).

By contrast, respondents held the lowest preference for leasing their buffer to another farmer, followed by establishing a u-pick operation. Although leasing and u-pick options reduce labor inputs by allowing others to assist in management duties, these options also require a breach of privacy. Armstrong and Stedman (2012) noted that producers are likely to hold strong attitudes toward private property rights, which can decrease their willingness to establish riparian buffers. These same attitudes may also play an important role in MCB management preferences.

4.7 Conclusion

Conservation buffer adopters surveyed in this study were generally somewhat to very interested in MCBs. This interest was influenced most by environmental outcomes of MCB plantings, including decreasing soil loss and improving wildlife habitat and water quality. Although more respondents considered MCBs more appealing than buffers with traditional conservation trees, this margin was small. MCB appeal was positively correlated to a landowner's perceptions of expected performance, as well as the presence of supportive social networks. As such, conservation agencies should promote the environmental benefits of MCBs and offer supportive assistance to ensure successful buffer performance.

Respondents also favored MCBs planted with nut and fruit producing trees, and preferred to either let their buffer grow naturally with minimal management or harvest buffer products for home use or sale. MCBs should be designed according to landowner objectives and site

conditions, but with an understanding that trees with nuts and fruit are generally preferred over brambles. Cost-share programs, like FSA's CREP, should also allow the occasional harvest of buffer products for home use or sale. These tangible products may encourage adopters to manage and maintain their buffers long-term, especially if they are equipped with the knowledge and resources to do so.

Although this study resulted in numerous findings that can inform future outreach and programming aimed at merging conservation and production in buffer zones, several research gaps remain. Future studies could further explore the impact of time, labor and reliable market availability on interest in MCBs and perceptions of harvesting and marketing effort. It may also be beneficial to further investigate the impact of knowledge and experience on MCB adoption, along with the types of extension and training preferred to reduce uncertainty. Supplemental research is also needed to explore additional design and management preferences and to determine why landowners prefer certain options. For example, research could investigate the influence attitudes toward private property rights have on u-pick and leasing management options, as well as preferred buffer size and vegetation density.

CHAPTER 5: CONCLUSION

5.1 Summary

The first objective of this study was to evaluate landowner perceptions of their conservation buffer and their intentions to retain long-term. Using two-step cluster analysis, four distinct conservation buffer experiences were captured, each differing significantly on their intentions to retain and perceptions of buffer land health impacts, maintenance effort and financial impacts. Adopters most inclined to retain their buffer perceived greater land health benefits and experienced fewer negative financial impacts and maintenance struggles. Variability across landowner segments was greatest among perceived land health impacts and maintenance effort, respectively. However, all segments shared the same top two conservation buffer adoption factors (financial cost-share assistance and improving water quality) and the top land management objective (improving my land's health).

The second objective was to determine landowner interest in and preferences for MCBs. Respondents were somewhat to very interested in MCBs and marginally considered them more appealing than buffers with traditional conservation trees. Friedman test results showed that interest was primarily influenced by potential environmental outcomes of MCB plantings. T-test results revealed that MCB appeal correlated positively to perceptions of greater expected performance and the presence of supportive social networks. Respectively, respondents preferred nut and fruit producing trees, and were most partial to letting their buffer grow naturally or harvesting buffer products for home use or sale.

5.2 Conclusion

Given that a majority of natural riparian forest buffers across the east coast have been removed to make way for agricultural production (Allen et al. 2001), it is imperative to identify

strategies for increased adoption and retention of the practice. Insights into the perceptions cost-share program participants have of conservation buffers can help natural resource professionals improve buffer experiences and long-term retention. In order to do this, results suggest that conservation buffer programs should implement strategies to reduce negative financial impacts and maintenance effort. Since adopters are generally more inclined to retain buffers that meet their initial adoption goals and expected environmental outcomes (Vandever et al. 2002), buffer designs and promoted benefits should align with these goals for the best chance of retention.

With an additional understanding of the preferences landowners have for MCBs, findings can also inform the creation of outreach strategies and programming geared toward merging conservation and production in buffer zones. To increase adoption of the practice, results suggest that the environmental benefits of MCBs should be promoted, and that conservation agencies should serve as a supportive resource to aid in successful buffer performance. Cost-share program policies would also benefits from permitting the occasional harvest of buffer products, as this may entice adopters to manage and maintain their buffers long-term.

5.3 Recommendations for Future Research

Although this study discerned that maintenance effort and financial impacts influence long-term buffer retention, supplemental research is needed to more specifically identify the types of maintenance and financial concerns that are most influential. Concerns may vary across landowner types, ranging from weed control and tree survival to farm income and land value. This information may help conservation agencies improve landowner experiences with their conservation buffers, ultimately encouraging practice retention.

Several factors that influence conservation buffer adopters' interest in MCBs were also identified in this study. However, additional research is still needed to ascertain why harvesting

buffer products for home use and sale was not very influential in MCB interest, especially since it was a preferred management option and has had significant effects in other MCB adoption studies (Robles-Diaz-de-Leon 1998; Trozzo et al. 2014). Given their correlation to adoption in previous research, a good starting point may be the impact of time, labor and reliable market availability, as well as knowledge and experience with NTFP species. The preferred types of training needed to reduce knowledge barriers and uncertainty will also be beneficial to practice adoption (Pattanayak et al. 2003).

Supplemental research is also needed to explore additional MCB design and management preferences, such as preferred buffer size and vegetation density. Lastly, future research could help discern design and management preferences by investigating the influence of factors like land aesthetics and private property rights attitudes, which have been reported as influential to adoption in the past (Ryan 1998; Kenwick et al. 2008; Armstrong and Stedman 2012).

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APPENDIX A: SURVEY COVER LETTER

VirginiaTech
College of Natural Resources and Environment

Department of Forest Resources and Environmental Conservation
Katie Commender
314 Cheatham Hall (0324)
Blacksburg, Virginia 24061
Email: katiecom@vt.edu
Phone: 540-231-9929

December 3, 2015

NAME
ADDRESS LINE
CITY STATE ZIPCODE

Dear <<Landowner>>,

About a month ago, we sent you a survey about *conservation buffer plantings* (e.g., riparian buffers, wildlife habitat buffers, hardwood tree plantings). As someone who has planted a buffer through the Conservation Reserve Enhancement Program (CREP) or the Conservation Reserve Program (CRP), we'd like to hear from you about your experiences and gather your thoughts (good or bad) about using fruit, nut and floral trees and shrubs in these types of plantings.

Because only a limited number of landowners have completed the survey, your participation is still very important to this project's success and your insight will help enhance conservation programs for Virginia landowners like you. For your convenience, a replacement survey is enclosed. We would be very grateful if you could take about 10 minutes to answer the questions, keeping your property with the established conservation buffer(s) in mind, and return it using the pre-stamped, business reply envelope. Participation is voluntary and responses are confidential.

If you have questions or concerns, do not hesitate to email or call. Thank you very much for your time, effort, and consideration. We look forward to hearing from you.

Respectfully,

Katie Commender,
Graduate Student
katiecom@vt.edu
540-231-9929

John Munsell,
Cooperative Extension

APPENDIX B: SURVEY INSTRUMENT

Fruit, Nut, and Floral Trees in Conservation Buffers

You've planted a buffer before, what do you think?

A Survey for Virginia Landowners

Whether you think planting fruit, nut and floral trees in a conservation buffer *(e.g., riparian buffer, wildlife habitat buffer, marginal pastureland buffer, hardwood tree planting)* is great or terrible, we want to hear from you. Your responses to this **short** questionnaire will help piece together a realistic picture of what Virginia landowners with buffer experience think about using these types of trees and shrubs. You will also have the chance to provide feedback about your overall satisfaction and experiences with your current conservation buffer(s). Your input will help improve the design and function of future conservation programs and will be used for a journal publication and thesis. The survey should take less than *10 minutes* to finish and is completely voluntary. Your responses will remain confidential. Thank you very much for participating!

Virginia Tech
College of Natural Resources and Environment

This questionnaire pertains to your land mentioned in the cover letter.
Please answer the following questions with this piece of land in mind.

1. How many years have you owned this land? _____ years

2. How many acres is this property? _____ acres

3. Are more than $1,000 worth of farmed products, including leasing fees, sold from your land per year?

☐ Yes ☐ No *(If no, skip to question #6)*

→ 4. **If yes**, how much time do you spend farming? **(Please check only 1 box)**

☐ Full-time (30 or more hours/week) ☐ Part-time (less than 30 hours/week) ☐ None (lease)

→ 5. **If yes**, what crops and/or livestock are produced on your farm? **(Please check *all* that apply)**

☐ Fruit and/or Nut Crops ☐ Row Crops ☐ Timber
☐ Livestock (e.g., cattle, poultry) ☐ Floral Crops ☐ Forest botanicals (e.g., ginseng)
☐ Forage Crops (e.g., hay) ☐ Other(s): _____

6. **Check** the **top 3** objectives that are most *important* to you when managing your land.

OBJECTIVES	Only *check* ✓ the top 3 reasons from the list
Increasing my income	
Improving my land's health	
Producing agricultural goods	
Passing my land on to heirs	
Increasing my land's value	
Enhancing beauty and scenery	
Improving my land's productivity	
Enhancing wildlife habitat	

7. **Check** the **top 3** factors that were most *influential* in your decision to adopt a conservation buffer.

REASONS	Only *check* ✓ the top 3 reasons from the list
Financial cost-share assistance	
Improving water quality	
Increase my CRP/CREP application score	
Enhancing wildlife habitat	
Yearly rental payments	
Conserving soil	

8. How satisfied are you with your buffer? **(Please circle only 1 response)**

Satisfied →

Not at all Slightly Somewhat Very Extremely

9. How effective has your buffer been at improving the health of your land? **(Please circle only 1 response)**

Effective →

Not at all Slightly Somewhat Very Extremely

10. How difficult has it been to maintain your buffer? **(Please circle only 1 response)**

Difficult →

Not at all | Slightly | Somewhat | Very | Extremely

11. How much of a negative financial impact has your buffer had on your land? **(Please circle only 1 response)**

Negative →

Not at all | Slightly | Somewhat | Very | Extremely

12. How likely are you to keep your buffer after your contract period ends? **(Please circle only 1 response)**

Likely →

Not at all | Slightly | Somewhat | Very | Extremely

We would now like to know about your interest in and opinions of planting fruit, nut and floral trees and shrubs in conservation buffers. Some plants native to this region are:

Blueberry	**Hickory**	**Hydrangea**	**Plum**
Elderberry	**Hazelnut**	**Pussy Willow**	**Pawpaw**

*We will refer to these plants throughout the rest of the survey as: **"fruit, nut and floral"** trees and shrubs.*

13. How interested are you in using fruit, nut and floral trees and shrubs in buffers? **(Please circle only 1 response)**

Interested →

Not at all | Slightly | Somewhat | Very | Extremely

14. Are buffers with fruit, nut and floral trees and shrubs *more* appealing than those with traditional trees (e.g., pine, oak)? **(Please check ✓ only 1 box)** ☐ Yes ☐ No

15. Would you ever plant a buffer with fruit, nut and floral trees and shrubs on your land? **(Please check ✓ only 1 box)** ☐ Yes ☐ No

16. If the following outcomes were true, how much would each *increase* your interest in using fruit, nut and floral trees and shrubs in a buffer planting? **(Please circle only one number for each outcome)**

OUTCOMES	Not at all	A little	Somewhat	Quite a bit	A lot
You get 75% of the planting paid for by the government	1	2	3	4	5
You make money selling food and flowers	1	2	3	4	5
You supply your friends and family with food and flowers	1	2	3	4	5
You improve water quality in the region	1	2	3	4	5
You improve wildlife habitat on your land	1	2	3	4	5
You enhance beauty and scenery on your land	1	2	3	4	5
You decrease soil loss on your land	1	2	3	4	5

YOU ARE MORE THAN HALF WAY DONE! PLEASE KEEP GOING.

17. How likely do you think the following outcomes would be if you planted a buffer with fruit, nut and floral trees and shrubs? **(Please circle only one number for each outcome)**

OUTCOMES	Extremely Unlikely	Unlikely	Somewhat Likely	Likely	Extremely Likely
Most of the trees would survive	1	2	3	4	5
The trees that live would grow lots of food and flowers	1	2	3	4	5
Water quality would significantly improve	1	2	3	4	5
The trees would make my land look sloppy	1	2	3	4	5
The amount of wildlife would dramatically increase	1	2	3	4	5

18. How much effort do you think each of the following steps would take to establish and maintain a buffer planted with fruit, nut and floral trees and shrubs? **(Please circle only one number for each outcome)**

STEPS	No Effort	Not Much Effort	Some Effort	Quite A Bit of Effort	A lot of Effort
Planning for the buffer planting	1	2	3	4	5
Planting the buffer	1	2	3	4	5
Managing the planted trees and shrubs	1	2	3	4	5
Harvesting the fruits, nuts and flowers	1	2	3	4	5
Marketing the fruits, nuts and flowers	1	2	3	4	5

19. What is your level of agreement with the following statements about buffer plantings with fruit, nut and floral trees and shrubs on your land? **(Please circle only one number for each statement)**

STATEMENTS	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I have the know-how to carry out this type of planting	1	2	3	4	5
The government has the know-how for this type of planting	1	2	3	4	5
I know where to find information about these types of plants	1	2	3	4	5
Putting money into it would be very risky	1	2	3	4	5
I have ***trust*** in the government to appropriately help me	1	2	3	4	5
There is a reliable market for the fruits, nuts and flowers grown	1	2	3	4	5
Natural resource professionals will strongly ***favor*** these plantings	1	2	3	4	5
Fellow landowners will think it is a good idea	1	2	3	4	5
Close friends and family will think it is a good idea	1	2	3	4	5

20. **Rank (1-6)** the types of ***native*** fruit, nut and floral trees and shrubs you'd prefer most in a buffer.

Types of NATIVE Trees and Shrubs	Rank 1 (most preferred) – 6 (least preferred)
Trees with nuts (e.g. hickory, black walnut)	
Shrubs with nuts (e.g. hazelnut)	
Shrubs with woody cut florals (e.g. hydrangea, red twig dogwood)	
Trees with fruit (e.g. persimmon, plum, pawpaw)	
Shrubs with berries (e.g. blueberry, elderberry)	
Brambles with berries (e.g. blackberry, black raspberry)	

THE SURVEY IS MORE THAN 75% COMPLETE. YOU ARE ALMOST DONE!

21. **Rank (1-5)** the management scenarios you would prefer most for a fruit, nut and floral buffer.

Management Scenarios	Rank 1 (most preferred) – 5 (least preferred)
Lease the buffer planting to another farmer who maintains, harvests and markets the fruits, nuts and flowers for their own personal profit	
Establish a **u-pick** in the buffer, where you maintain the plantings and customers harvest the fruits, nuts and flowers for a set price	
Personally maintain, harvest and market the fruits, nuts and flowers to local **farmer's market** customers for high value prices	
Maintain and harvest the fruits, nuts and flowers for **personal use** at home or to **share** with family and friends.	
Let the buffer grow **naturally** without much maintenance and no harvesting (e.g. for wildlife habitat, hunting, beauty and scenery)	

We are interested in the demographics of those participating in conservation buffer programs. We understand that the following questions request personal information and you may not be comfortable answering. Please know that we will, by law, keep this information confidential and your responses are very helpful for our study.

22. What year were you born? _____

23. What is your gender? ☐ Male ☐ Female

24. What is (*was if retired*) your primary occupation? _____

25. What is the highest level of education you have completed? **(Please check ✓only 1 box)**

☐ Some high school ☐ High school graduate or GED ☐ Some college
☐ Associate degree ☐ Bachelor's degree ☐ Graduate degree

26. What was your approximate 2014 household income before taxes? **(Please check ✓only 1 box)**

☐ Less than $25,000 ☐ $25,000 to $50,000 ☐ $50,000 to $100,000
☐ $100,000 to $150,000 ☐ $150,000 to $200,000 ☐ Over $200,000

27. If you have other comments, including ideas about conservation buffer design, please write them in the space provided below. Feel free to use the back of this page if you need more room.

_____
_____
_____
_____
_____
_____
_____
_____

You're finished! Thank you so much for your time and effort. Please fold the survey in thirds and return it in the pre-addressed envelope. No postage is required.

This number is a way for us to tell if you have returned the survey so we do not send you additional materials. We use a number so that your name is not on the survey. →

APPENDIX C: INSTITUTIONAL REVIEW BOARD PERMISSION LETTER

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: September 22, 2015

TO: John F Munsell, Katie Elene Commender

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires July 29, 2020)

PROTOCOL TITLE: Landowner Intentions to Retain Riparian Forest Buffers under Various NTFP Scenarios

IRB NUMBER: **15-001**

Effective September 22, 2015, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the Amendment request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Expedited, under 45 CFR 46.110 category(ies) 5,7**
Protocol Approval Date:	**January 30, 2015**
Protocol Expiration Date:	**January 29, 2016**
Continuing Review Due Date*:	**January 15, 2016**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.