

ABSTRACT

CHIZMAR, STEPHANIE JO. An Analysis of Financial Incentive Programs for Forest Landowners. (Under the direction of Dr. Rajan Parajuli and Dr. Robert Bardon).

Forests produce a variety of market as well as non-market goods and services, yet economic activities negate to completely capture the non-market goods and services without market intervention. Accordingly, decisionmakers structure incentive programs for forest landowners, such as preferential tax policies and direct financial payments, to reduce costs and/or increase profits from forest management, and thus correct the market failure preventing socially optimal production of forest-based goods and services. Specifically, these landowner assistance programs incentivize forest management practices, many of which promote complementary production of market and non-market forest-based goods and services.

This dissertation, a conglomerate of three papers, reviews and assesses various economic instruments utilized in state-level incentive programs for forest landowners. The first paper (Chapter Two) features a regional examination of cost-share reimbursement programs for forest landowners in the thirteen southern states through a review of relevant literature paired with an extensive online search of state forestry agency websites. We find that while nine state-level programs exist in the U.S. South, only seven have active funding; however, many of the programs identified, including the North Carolina Forest Development Program (FDP), are under increased budgetary constraints.

The second paper (Chapter Three) follows with a focused examination of the FDP to pinpoint which factors are associated with the likelihood of funding cost-share project applications that will be completed by forest landowners and include reimbursement payments that fully utilize approved allocations. Results from various estimated models suggest that FDP applications associated with chemical release treatments (site preparation), pine hand-planting

activities, and larger applied acreage values are more likely to be completed and implemented as defined in the initial application. Conversely, our findings indicate that the probability of funding completed applications and those that fully utilize allocations is negatively associated with the base fund, non-corporate ownerships, burning practices (site preparation), activities with a 40% cost-share rate, and applications funded 2017 and prior.

Finally, in the third paper (Chapter Four), we review state preferential property tax programs (PPTP) in North Carolina, Nebraska, Wisconsin, New York, and Oregon with respect to their treatment of agroforestry practices, land-uses that intentionally integrate trees, crops, and livestock for economic, environmental, and social benefits. We completed this objective through systematically evaluating the suitability of various characteristics of agroforestry practices with each program identified. We conclude that agricultural tax assessments are more likely to favor multi-use agriculture and forestry systems than the preferential tax assessments of forest lands. Results from the analysis indicate forest farming and alley cropping to be the most common agroforestry practices allowed under preferential tax classifications in the study states.

Budgetary constraints largely limit the extent of cost-share programs to be able to subsidize forest management on private forestlands. Additional funding for cost-share assistance is necessary to meet current and future demand. Evidence from the studies in this dissertation support that future program modifications and adaptations continue to capitalize on the complementary elements of incentive programs for forest. For example, the incentive programs identified in this report aim to reduce economic pressures on forest landowners while simultaneously encouraging active forest management and foster complementary production of market and non-market forest-based goods and services. Lastly, decisionmakers should consider

expanding the emphasis of non-market forest products within incentive programs to reach a more extensive and diverse audience of landowners for sustainable management of forest resources.

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An Analysis of Financial Incentive Programs for Forest Landowners

by
Stephanie Jo Chizmar

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APPROVED BY:

Rajan Parajuli
Committee Co-Chair

Robert Bardon
Committee Co-Chair

Erin Sills

Frederick Cubbage

Gregory Frey

DEDICATION

In memory of

Rudolph Chizmar

For introducing me to loves for trees, travel, and counting money

BIOGRAPHY

Stephanie Chizmar is originally from the Ohio River Valley but moved with her parents and brother to southeastern NC when she was a child. Stephanie obtained a B.S. in Environmental Science (Concentration: Conservation Science) and a B.A. in Spanish Language and Literature at the University of North Carolina-Wilmington in 2014. She completed study abroad tours in Peru and Costa Rica while studying in Wilmington. She returned to Peru to research agroforestry systems for her thesis (“A Comparative Economic Assessment of Silvopasture Systems in the Amazonas Region of Peru and in North Carolina, USA”) under the direction of Dr. Erin Sills and Dr. Fred Cabbage, among others, at North Carolina State University. She successfully defended her thesis in 2018 and graduated with a M.S. in Natural Resources (Concentration: Economics and Management; Minor: Forestry). She subsequently pursued a Ph.D. in Forestry and Environmental Resources with a focus in forest extension and economics at North Carolina State University under the direction of Drs. Rajan Parajuli and Robert Bardon. She hopes to continue work as a researcher in forest economics and policy with aspirations of becoming a university professor.

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CHAPTER 1: INTRODUCTION

Forest and woodlands encompass over one-third of the United States (U.S.) landscape, 58% of which are owned by private entities including individuals, partnerships, trusts, estates, associations, organizations, and corporations (Oswalt et al. 2019). The U.S. Forest Service's Forest Inventory and Analysis (FIA) program groups and defines individual and family ownerships, inclusive of trusts, estates, and family partnerships, as family forest owners (FFO) (Butler et al. 2020). FFO hold 38% of the forest and woodlands in the nation, while corporate landholders own the remaining 20% of private forest and woodlands (Oswalt et al. 2019). Regardless of ownership, forests produce a variety of market and non-market goods and services. However, economic activities negate to completely capture non-market goods and services, or public goods, without market intervention (Frey et al. in review). As a result, decisionmakers utilize strategies such as fiscal (tax) policies and direct financial payments to correct the market failure preventing socially optimal production of forest-based public goods and services (McGinley and Cabbage 2020).

Decisionmakers and program administrators structure incentive programs for landowners, including but not limited to preferential property tax assessment and cost-share reimbursement programs, to reduce costs and/or increase profits from forest management, and thus internalize the external activities associated with public goods from forests (Chizmar et al. 2021; McGinley and Cabbage 2020; Frey et al. in press). Specifically, these landowner assistance programs incentivize forest management practices, many of which promote complementary production of market and non-market forest-based goods and services. For example, incentive programs commonly subsidize regeneration, afforestation, site improvement, and timber stand

improvement activities which not only promote production of wood-based products but also directly and indirectly support and protect forest-based ecosystem services.

This dissertation reviews and assesses various economic instruments utilized in state-level incentive programs for forest landowners. The first paper (Chapter Two) examines cost-share reimbursement programs for forest landowners in the thirteen southern states. The review in the first paper also identifies the current status of state-level cost-share programs in the U.S. South in terms of annual funding and accomplishments (i.e., acres treated, trees planted, etc.). We achieved this through examining relevant literature published after 1980 in addition to an extensive online search of state forest agency websites. We find that while nine programs still exist in the U.S. South, only seven have an active funding source, many of which are under increased budgetary constraints. We conclude Chapter Two with a discourse on current prospects regarding funding, partnerships, and broadening the focus of state-level cost-share programs in the U.S. South to cover forest-based ecosystem services.

In the second paper (Chapter Three), we analyze a state-level cost-share program, the North Carolina Forest Development Program (FDP) to provide a more-concentrated examination. We evaluate the factors associated with completed cost-share projects and those which reimbursements equate to the allocations approved in applications. We accomplished this through developing and estimating various models with various structures and specifications, to separate the influence of variable costs and treatment acres on the likelihood of funding cost-share applications that will be completed and paid the originally approved allocation. Results suggest that the following characteristics are positively associated with cost-share projects that will be completed and will receive the total allocation: chemical release treatments (site preparation), pine hand-planting activities, and larger applied acreage values. Meanwhile,

applications associated with the FDP base fund, non-corporate ownerships, burning practices (site preparation), activities with a 40% cost-share rate, and applications funded 2017 and prior are negatively related to completed projects and the full utilization of allocations.

The third paper (Chapter Four) assesses an alternate state-level incentive instrument for landowners: preferential property tax assessment for agricultural and forest lands. In this chapter, we review state preferential property tax programs (PPTP) in North Carolina, Nebraska, Wisconsin, New York, and Oregon relevant to agroforestry practices, land-uses that intentionally integrate trees, crops, and livestock for economic, environmental, and social benefits (U.S. Department of Agriculture 2021). We develop a database of PPTP and systematically delineated which programs support or prevent enrollment through examining the suitability of agroforestry practices with each program identified. We conclude that agricultural tax assessments are more likely to favor multi-use agriculture and forestry systems than the preferential tax assessments of forest lands, at least in the five states investigated. Results from the analysis indicate forest farming and alley cropping to be the most common agroforestry practices allowed under preferential tax classifications.

Lastly, Chapter Five summarizes the unique findings drawn from the various studies included in this dissertation and their implications for future policy. We also identify the limitations of the investigations described in this dissertation. Finally, we discuss prospects for continuing and future research.

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CHAPTER 2: STATE COST-SHARE PROGRAMS FOR FOREST LANDOWNERS IN THE SOUTHERN UNITED STATES: A REVIEW

Abstract

The largest concentration of state-level forest cost-share programs in the United States can be found in the southern states. Since the inception of the first programs in the 1970s, the state-level forest cost-share programs in the U.S. South have acted as models for the rest of the country. Cost-share programs compensate landowners through direct reimbursements to address barriers such as limited owner capital and cash flow in the initial years of investment. Through a review of the literature and progress reports from Southern state forestry agencies, we qualitatively assessed state-level cost-share programs and their status in the southern states. We identified the common themes in the literature related to cost-share programs: market, non-market, and landowners' perceptions and knowledge. Many of the programs enacted between the 1970s and 1980s aimed to ensure a sustainable timber supply, a market good, from private forestlands. A few of the programs enacted more recently compensate landowners for non-market benefits such as forest health or soil and water conservation. Two of the nine available programs are practically inactive in recent years due to a lack of funding. We discuss current prospects regarding funding, partnerships, and broadening the focus of incentives to cover forest-based ecosystem services.

Keywords: forest landowners, reimbursement, cost-share programs, U.S. South, ecosystem services

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Introduction

Financial incentives for private forest landowners utilize a variety of financial instruments, typically combined with technical assistance and forest management planning, to promote better forest management (Meeks 1982, Cabbage et al. 2020). These financial incentives often come in the form of preferential tax policies and direct financial payments administered as cost-share programs. Landowners participating in cost-share programs may receive direct reimbursements or annual payments spread over 10- to 30-year time horizons to implement approved forest management practices (Cabbage et al. 2020). Common incentivized practices include tree planting and timber stand improvement to foster timber production, improve habitat for wildlife, or promote forest health. These programs typically address barriers landowners face, such as limited capital and cash flow in the initial years of investment (Haines 1995, Granskog et al. 2002).

Traditionally, these incentive programs stemmed from commodity production purposes, but in recent times, expanded objectives to provide environmental services. Such new programs will be similar to prior reforestation programs in many respects, only with broader objectives of providing ecosystem services such as carbon capture, clean water, or biodiversity. Thus, examining how prior forest incentives programs occurred will provide insights if we expand forest incentives programs. Ambitious efforts to double the planted forest area in the U.S. and capture carbon (Trillion Trees 2020, Fargione et al., 2020) present a salient new prospect for forest incentive programs, which would be required to reach such a major goal.

The premise behind all public incentive programs is that private markets alone will not provide a socially acceptable level of goods or services. This may be particularly true for the case of public goods such as long-term supplies of timber (an intertemporal market failure) or for

common pool goods and services such as air, water, and carbon storage (non-market, unpriced goods). State-level forestry cost-share programs have been characterized as “gateway programs”, which attract landowners with financial incentives and then inform the landowners of the expected environmental, or non-market, benefits associated with the subsidized practices (Ma et al. 2012). Landowner participation in cost-share programs has been largely concentrated among non-corporate owners with 100 acres or more of private forestland and woodlands in the U.S. South (Ma et al. 2012).

The U.S. South consists of just over 212 million acres of private forestland in which about 143 million acres are owned by non-corporate landowners (Oswalt et al. 2019). In 2006, almost 50% of the non-corporate landowners in the U.S. South owned forests for their market benefits such as timber production and their long-term investment potential (Butler and Wear 2013). Results from the National Woodland Owner Survey (2011-2013) identified over 100 million acres of forestland in the southern states which are owned for non-market objectives rather than market benefits such as family legacy, scenic beauty, and protection for wildlife (Butler et al. 2020).

A few past review studies examined the forestry financial incentive programs including the state-level cost-share programs in the United States (Haines 1995, Granskog et al. 2002, Kilgore et al. 2007). Haines (1995) identified 19 state cost-share programs for forestry practices, 10 of which were located in the U.S. South. Granskog et al. (2002) reported that state cost-share programs in the United States doubled their accomplishments between 1993 and 2000. Kilgore et al. (2007) recommended actions to improve landowner awareness and appeal of state financial incentive programs, including cost-share, such as increased program funding and designing programs to address regional differences in forest characteristics and landowner objectives. Since

these studies were published, a number of new studies evaluated several aspects of forest cost-share programs in the southern states (Li and Zhang 2007, Jacobson et al. 2009, Watson et al. 2013, Greene et al. 2013, Wolde et al. 2016, Koesbandana et al. 2017, Stoots et al. 2017). Similarly, over the years, states have developed, modified, and discontinued several state-specific cost-share programs for private forest landowners.

The purpose of this review is to summarize major characteristics of the literature and fill a current gap in forest policy research centered on the status and framework of state forestry cost-share programs in the southern United States, as (1) models for state programs in other regions in the U.S. (Mehmood and Zhang 2002), and (2) for consideration for expansion if incentives are offered for provision of broader ecosystem services. The South has had the most cost-share programs in the nation, and has slowly expanded the purview of these programs, which makes this review informative for research and application.

Based on the review of the literature and state-level annual accomplishment reports, this study updates the current status and extent of state-managed cost-share programs in the 13 southern states and evaluates the opportunities and challenges associated with those programs. The annual progress reports published by state agencies summarize the program details such as enrolled number of landowners, enrolled acres, and fund administration and accounting (Fecso et al. 1987). We do not cover the extensive Federal USDA programs, and suggest a recent review by Cubbage et al. (2020) as a reference for these.

This study attempts to shed light on the major bottlenecks of these limited programs and presents some recommendations to sustain and expand these crucial landowner assistance programs. Several of the programs reviewed in past studies are no longer operating, have changed substantially, or have experienced decreased funding in recent years. There is a need to

re-assess state-level cost-share programs regarding their structure, funding sources, and administration. It is important to discuss the relevance of having state cost-share programs, particularly for the states that either no longer have a state-level program or never implemented one. As such, the suitability of other venues for cost-share assistance as a substitute to state-provided funds is worth considering. Based on the literature and program accomplishment reports, this South-centered study provides important insights to regional forest characteristics and landowner objectives, which may also be relevant for state governments outside of the U.S. South.

Methodology

We searched for published literature on forest incentive programs in the U.S. utilizing Google Scholar, North Carolina State University Summons, and the Commonwealth Agricultural Bureau (CAB) abstracts. To further identify related articles that met our criteria, we utilized “snowball sampling” (Floress et al. 2018). We also examined recent articles that cited the articles in our database by using the forward searching method. Searches in Summons and CAB abstracts were limited to peer-reviewed literature while searches in Google Scholar included related grey literature. Various combinations of keywords such as “forest incentive program,” “forest financial policy,” and “cost-share program” were used in these online searches.

Once a pool of literature on forest incentive programs was established, we categorized the studies by type of incentives, geographical scope and location, year of publication, and main findings. Forest incentives include multiple mechanisms including tax policies, conservation easements, and direct payments such as cost-share reimbursements. In this study, we distinguished cost-share programs as a subset of all financial incentives. 64 studies out of 86 forest incentive-related studies considered cost-share programs. State incentives tended to be

explored less than federal programs in past studies, 44 as compared to 62 studies, respectively. Only 38 studies covered the southern region in their analysis.

We restricted our analysis to the largest wood basket in the world covering the 13 southern states: Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia (Figure 2.1). We focused our analysis on literature that explored cost-share programs in the U.S. South, particularly state-level programs, as referenced in Figure 2.2. We identified and grouped common topics evaluated in the literature on state cost-share programs. We categorized sub-topics according to their relationship or correlation with state cost-share programs, as noted in the literature: (a) positive, (b) negative, and (c) mixed, both positive and negative. In quantitative studies, we utilized the sign and value of the variables related to state cost-share programs. Whereas, in qualitative studies, we associated the observations related to state cost-share programs to our defined categories. For instance, multiple studies identified limited participation in state cost-share programs as an area for improvement, or negative correlation as included in our analysis. Appendix A summarizes the published literature focused on state-level forestry cost-share programs in the U.S. South with their main findings. We highlighted main features of those articles according to their general topical foci.

We also reviewed state agency websites and reports, which published the accomplishments and status of state cost-share programs in the U.S. South. Many states regularly publish annual or biannual reports on the accomplishments of public programs. State agencies have measured the accomplishments of programs since their inception through the number of acres that receive cost-share assistance and the total cost-share payments dispersed to those acres (Fecso et al. 1987, NCFS 2019, SCFC 2020a, VDOF 2020b). The reports published by state

agencies were reviewed exclusively to illustrate the current extent, issues, and opportunities of state cost-share programs in the U.S. South. Following Haines (1995) and Granskog et al. (2002), we documented the main characteristics of these state-programs in terms of the objectives, eligibility requirements, management practices, and funding for reimbursement payments. We then compared the state cost-share programs in the U.S. South through the context of the characteristics identified in the literature.

Results

Main Topics Explored About the State Cost-Share Programs

Table 2.1 summarizes the characteristics, in counts and percent of total studies, of the two literature pools: (1) literature database on forest incentives in the U.S. and (2) literature sample on state-level cost-share programs in the U.S. South. For instance, 63% of the studies, or 54 out of 86 studies, in the literature database on forest incentives included state-level programs in their analyses. Out of the 86 studies in our literature pool, only 21 papers featured analysis of state cost-share programs in the U.S. South—the majority of which were published in the 1980s or 2010s. Six of the 21 studies focused exclusively on state programs. The remaining 15 studies had a broader focus on both federal and state incentive programs in the U.S. South. All but five studies included cost-share programs with timber production objectives.

The 21 studies evaluated the impacts of cost-share programs according to three generalized topics: (1) economic or market-related, (2) environmental or non-market related, and (3) landowners' perceptions and knowledge. We recorded 39 occurrences of the topics in the literature sample. Table 2.2 lists the topics and sub-topics explored in the literature related to state-level cost-share programs along with their frequencies. The topics related to economics

were found the most explored, with 19 counts, followed by those related to landowner perceptions and knowledge, and the environment. The topics are explained in detail below.

Economic or Market-Related Topics

Studies that explored economic or market-related topics focused mostly on investment in reforestation. Eight of the nine reforestation-related cases found landowner investment in regeneration strategies to be positively related to state-level cost-share programs. Flick and Horton (1981) estimated that approximately 20% of the acres planted between 1972 and 1977 in Virginia received cost-share payments from the Reforestation Timberlands Program. Hardie and Parks (1991) concluded that cost-share payments funded 70% of pine regeneration investment in the South between 1971 and 1981, and reported that increasing the cost-share reimbursement rate would be an effective policy for more pine plantation acreage (Hardie and Parks 1991). Weaver and Bullard (1983) also reported that the Mississippi's Forest Resource Development Program contributed to regeneration activities on over 150,000 acres from 1975 to 1981.

The literature differed in the role capital substitution played in private investment in reforestation. Capital substitution occurs when public dollars replace private investments that would have occurred without government support. Studies have utilized econometric modeling to estimate the effects of assistance programs on landowners' decisions to invest in reforestation (Cohen 1983, de Steiguer 1984, Royer 1987). The econometric models examined whether the level of cost-share payments induces a change in private investment in reforestation. Capital substitution prevails when increasing cost-share payments does not lead to increased investment. de Steiguer (1984), Brooks (1985), and Royer (1987) found no evidence of substitution in private investment associated with reforestation. Cohen (1983) and Li and Zhang (2007), however, stated that capital substitution effects existed in private investment of reforestation using the

cost-share assistance in Mississippi, North Carolina, and Southern Florida. In other words, government payments replaced at least some portion of landowner capital to finance reforestation efforts that would have occurred without governmental assistance.

Other relevant sub-topics include the benefits of state-level cost-share programs and the impact of programs on timber production. State-level cost-share programs were found to positively impact both private and public net benefits from forests: the market and non-market goods and services produced less their associated costs or expenditures (Brooks 1985, Flick and Horton 1981, Koesbandana et al. 2017, Stoots et al. 2017). Brooks (1985) concluded that present-value public benefits of cost-share programs exceeded the discounted program costs, resulting in net positive returns. Flick and Horton (1981), Koesbandana et al. (2017), and Stoots et al. (2017) estimated benefit-cost ratios of 3.5 in Virginia, 2.4-3.0 in North Carolina, and 5.0 in South Carolina for each of their state's cost-share program, respectively. Brooks (1985) confirmed the belief shared among policymakers in states with their own program that cost-share payments to non-industrial private forest landowners could increase softwood inventory and harvests, which ultimately drive timber markets.

Environmental or Non-Market Topics

Three environmental, or non-market-related, sub-topics – ecosystem services, sustainable forest management, and wildlife habitat – were discussed five times in the sample, particularly in the more recently published studies. Based on perceptions of forest managers, Jacobson et al. (2009) reported that state cost-share programs ranked high in promoting sustainable forest management. Greene et al. (2013) concluded that state cost-share programs were effective in protecting wildlife, water quality, soil productivity, and preventing forest conversion and parcelization. Watson et al. (2013) reported that approximately 50% of the surveyed landowners

in Virginia participated in a pre-commercial thinning cost-share program to improve aesthetics, the environment, and wildlife habitat, and over 70% participated to reduce potential pest outbreaks.

Moreover, Tian et al. (2015) revealed that incentives in Tennessee in the form of governmental payments were positively related to landowner interests in carbon sequestration. Similarly, Kreye et al. (2018) found evidence that government interventions including financial incentives increased the odds of landowners adopting wildlife best management practices in Florida. It is important to note that the non-market, environmental benefits discussed in the literature typically refer to public benefits, those shared by the landowner and society alike. Whereas the market benefits discussed in the prior section pertain primarily to private benefits, experienced exclusively by the landowner. In either case, however, landowners and the cost-share provider bear the costs necessary to produce the market and non-market benefits.

Topics related to Landowners' Perceptions and Knowledge

Topics related to landowners' perceptions and knowledge were found 15 times in our pool of literature. Associated sub-topics from the literature included program participation, compatibility with other policies, landowner awareness of programs, landowner objectives, and landowner trust in governmental assistance. English et al (1997), Jacobson et al. (2009), and Wolde et al. (2016) evaluated the multiple sub-topics regarding the state cost-share programs. English et al. (1997) reported that objectives related to water quality, wildlife habitat, and timber were more likely to motivate Tennessee landowners to participate in the state's stewardship program than potential cost-share benefits. Jacobson et al. (2009) determined that state incentive programs ranked high in overall landowner appeal and in assisting landowners to meet timber- and conservation-related objectives. Wolde et al. (2016) suggested that forest landowners were

less likely to enroll in cost-share programs if the landowners had smaller forestland holdings, less education, and shorter ownership tenure. In sum, the findings from these studies suggested that cost-share programs correlate more with multiple management objective landowners with larger landholdings capable of producing multiple benefits.

Brooks (1985) reported on the limitations of cost-share programs, such as low enrollment rates, in addition to the potential of cost-share programs to provide public benefits and increase timber supply. Watson et al. (2013) found that education and ownership preferences significantly predicted the willingness of landowners to participate in Virginia's Pine Bark Beetle Prevention Program, a cost-share program which partially reimburses the expenses related to pre-commercial thinning. Sun et al. (2009) found that landowner's knowledge of the Mississippi's Forest Resource Development Program was positively related to the land size, regeneration experience, gender, and forestry association membership. However, application frequencies for the Mississippi's cost-share program were higher for landowners with small ownerships, lower education and income levels, and non-members of associations (Sun et al. 2009), findings in direct contrast to the those from Wolde et al. (2016).

Royer (1987) concluded that knowledge of federal tax incentives for reforestation efforts in North Carolina might not increase the probability of reforestation where cost-sharing is widely used, suggesting that tax incentives had limited additive effects. At the regional scope, however, Royer and Moulton (1987) estimated that the probability of reforestation was increased by almost 20% if a landowner in the U.S. South was familiar with either tax incentives or cost-share programs and almost 40% if familiar with both tax incentives and cost-share programs. Kreye et al. (2018) found that family forest owners in Florida were motivated by their own ownership preferences as landowners have various management objectives. In addition, Kreye et al. (2018)

identified that family forest landowners in Florida were skeptical of governmental interventions, in the form of incentives and regulatory assistance, to manage their private lands. These landowners may not have desired to deal with the costs of cost-share participation in terms of the associated bureaucracy.

Current Extent of State-Level Cost-Share Programs

Table 2.3 presents the program details including eligibility criteria, funding details, and recent accomplishments of each state cost-share program. State cost-share programs' annual payments in the U.S. South cover subsidized reforestation, site preparation, and timber stand improvement activities on over 150,000 acres of private forestland. The Reforestation Foundation Program in Texas and Florida's Reforestation Incentives Program and Plant a Tree Trust Fund Program have been discontinued (Granskog et al. 2002). Florida's Reforestation Incentives Program ended in 1993 due to budget cuts and the closure of all but one state tree nursery (Haines 1995). Oklahoma's Forest Resource Development Program is still technically active; however, it does not have a current funding source (Oklahoma Forestry Services 2020). Alabama's Agricultural and Conservation Development Commission Program operates with a very limited budget, originally funded through interest on an oil and gas trust fund, and has not received state appropriations for cost-share reimbursements in several years (Alabama Soil and Water Conservation Committee 2019). Below, we summarized the commonalities and differences of state-level cost-share programs available to forest landowners in the U.S. South.

Similarities in the State Cost-share Programs

In general, the missions of state cost-share programs enacted are related to the production of natural resource commodities such as timber and some environmental services associated with sound forest management. This is true for the U.S. South where state cost-share programs are

similar in their objectives and management requirements and state forestry agencies are responsible for managing and administering these programs. The programs enacted before the 1990s typically were designed to provide incentives for timber production to meet the pervasive concern for an adequate future timber supply for the forest industry in each state. A few programs enacted more recently included program objectives for broader conservation efforts of wildlife management or soil and water conservation on private forestlands (Table 2.3). All cost-share programs in the U.S. South provide cost-share payments for reforestation and site preparation, but only Alabama, Louisiana, Mississippi, North Carolina, South Carolina, and Tennessee also provide cost-share payments for timber stand improvement activities.

Non-industrial private forestland owners in the southern states are eligible to receive state cost-share reimbursements on qualifying acres not enrolled in any of the federal cost-share programs. Programs in Mississippi and South Carolina restrict cost-share assistance solely to non-industrial private forest landowners. Each state-level cost-share program requires landowners to have an approved management or stewardship plan to qualify for the program, reinforcing the “gateway program” benefits. Seven programs require landowners who receive cost-share funds to maintain forest management on the acreage associated with cost-share reimbursements for five to 15 years.

The demand for cost-share payments, measured through annual applications for cost-share funds, far exceeds the available funds in all states, except Tennessee. In addition to the discontinued and unfunded programs already discussed, programs in North Carolina and Kentucky have both experienced decreased funding. North Carolina’s Forest Development Program (FDP) experienced a waiting list of 300 to 600 landowners annually between 2010 and 2016 due to insufficient funds (NC Forest Service 2019). Kentucky’s state program disbursed

\$6.5 million annually on average from 2008 to 2012 and \$3.5 million annually on average from 2013 to 2019 (Kentucky Department of Natural Resources 2020). Kilgore et al. (2007) emphasized limited funding as one of the major impediments of financial assistance programs for family forest landowners.

Differences among the State Cost-Share Programs

There are notable differences among the cost-share programs in the U.S. South. Priorities for conservation practices are the main goals in some states with Alabama, Kentucky, and Tennessee combining assistance for forest landowners and agricultural producers into the same program. The scope of Alabama's state program, for instance, goes beyond payments for establishment and improvement of timberlands to include reimbursements for costs associated with soil conservation and water quality improvement. Kentucky's Soil and Water Quality Cost Share Grant Program provides funds for soil and water protection and improvement measures including forestry practices to control erosion and protect riparian areas. The Tennessee Agricultural Enhancement Program promotes long-term investments in livestock, farming operations, and forest resources. In contrast, state cost-share programs such as the North Carolina Forest Development Program and South Carolina Forest Renewal Program focus on reforestation and timber stand improvement activities that promote commercial timber production (NCFS 2019, South Carolina Forestry Commission 2020a).

Most state programs, with the exception of the state programs in Kentucky and Mississippi, require a certain acreage limit for either land ownership or the project treatment area. Minimum acreage constraints range from one to 20 acres and maximum constraints vary from 100 to 1,000 acres (Table 2.3). Alabama and Tennessee require applicants meet both an ownership and a project treatment acreage. South Carolina's state cost-share program requires a

minimum of 10 acres for mechanical site preparation. Virginia's Reforestation of Timberlands Program requires a minimum of five acres, as opposed to one, if site preparation is required. Qualifying lands for the Tennessee Agricultural Enhancement Program must be at least 10 acres of forestland, of which, five must be contiguous; however, forest area size is waived when in a riparian zone.

Given the differences in the focus and priority of the programs, treated acreage aggregated for all practices varied by states from 231 acres (Alabama) to 44,574 acres (North Carolina). Annual totals of cost-share payments in the southern states also differ considerably. For instance, in 2018, Tennessee disbursed approximately \$30,000 to forest landowners through their Agricultural Enhancement Program while Virginia disbursed almost \$2.5 million in cost-share reimbursements to forest landowners through their Reforestation of Timberlands Program (Tennessee Department of Agriculture 2019, Virginia Department of Forestry [VDOP] 2020b). Reimbursements rates of state-level cost-share programs range from 40% to 75% (Table 2.3). States such as Mississippi and North Carolina vary the cost-share rate depending on management practice and tree species.

Another significant difference among these programs is the funding source. Sources include state appropriations, severance tax, trust funds, program fees, voluntary assessments, and private contributions. The most common sources of funding utilized by eight of the 13 southern states are state appropriated funds or industry related funding in the form of a tax or voluntary assessment. Funding based on yield and severance taxes varies from year to year with annual timber harvest levels. Currently, five programs funded through state appropriations and industry related funding, and two programs funded only through state appropriations currently distribute annual cost-share payments (Table 2.3). Coastal states such as Georgia and North Carolina often

receive funds, both from federal and state sources, for cost-share payments in response to hurricanes and other catastrophic weather events.

The process to determine who is eligible for funding varies from program to program. States utilize ranking systems, distribute funds on a first-come, first-served basis, or select applications based on a lottery-system. States that utilize ranking systems include Kentucky, South Carolina, and Virginia. Ranking is often based on timberland characteristics such as conservation value, potential productivity, or the region's proportion of the state's harvested timber products. Ranking applications can be a useful allocation strategy for program administrators with specific objectives such as improving soil and water quality of sensitive lands. However, a lottery-system may be a more equitable allocation strategy than a ranking-system since landowners have an equal chance of receiving funding, as long as landowners only submit one application per funding period.

Allocation of funds for Kentucky's state program is prioritized by conservation districts and ranked according to a weighted average of the specific practice value, with agricultural waste control systems as the top priority, and treatment acreage. South Carolina's Forest Renewal Program bases allocations on a county's proportional contribution to statewide harvested timber products. After the enrollment period, applications are continuously funded regardless of county using funds from incomplete projects, or slippage funds (SC Forestry Commission 2020b). Oldest harvested tracts are given first priority before May 31st of each year for Virginia's state cost-share program. After that date, applications are approved on a first-come, first-served basis (VDOF 2020a, 2018). States that also utilize a first-come, first-served approach include Louisiana, Mississippi, and Tennessee. The Forest Development Program in

North Carolina recently changed from distributing funds on a first-come, first-served basis to a lottery-based system in an attempt to more-fairly distribute limited funds (NCFS 2017, 2019).

Discussion

Based on the review of literature and program accomplishment reports, we documented the main topics discussed in the literature and the current status of state cost-share programs in 13 Southern states in the U.S. These programs are structured for self-governance, meaning the state agencies are solely responsible for program planning, administration, implementation, and adaptive management. This self-governance facilitates the ability of state cost-share programs to adapt to meet the needs of local landowners, trends, and issues. The literature has long recognized the extent of these programs in reforestation efforts as well as their influence as historical models for cost-share programs in states outside of the U.S. South (Mehmood and Zhang 2002, Ma et al. 2012). In addition, this review of commodity, wildlife, and soil conservation programs offers insights into possible additions to existing programs or for new programs to provide incentives for ecosystem services. We present a few observations on the issues and opportunities associated with the state cost-share programs below.

Economic, environmental, and landowner factors

Prior research on the economic effects of incentive programs found that landowners usually were responsive to such financial incentives and would perform more reforestation or timber stand improvement activities. A few studies, but not most, found that public funds substituted for private capital. But we might suggest that this is not so common at the relatively low program funding levels currently available, and certainly would not be the case if programs were instituted to plant massive new areas with trees. In fact, only incentives would garner success at planting major new land areas in the U.S.

Most research did find that landowners would be amenable to increasing their production of ecosystem services and that incentive programs would help prompt their participation. Past and recent studies have identified interest in wildlife practices, carbon storage, sustainable conservation of forestlands, and other forest-based amenities (English et al. 1997, Jacobson et al. 2009, Tian et al. 2015, Snyder et al. 2019). Landowner participation has been documented to depend on their characteristics including but not limited to education and demographics, motivations and objectives, and land size. Landowner participation also depends on external characteristics such as interest rates, stumpage prices, and other factors related to the availability of cost-share funds (de Steiguer 1984, Hardie and Parks 1996, Kreye et al. 2018, Li and Zhang 2007, Sun et al. 2009, Watson et al. 2013, Wolde et al. 2016).

Funding

Limited funds and capacity have constrained the implementation of these programs considerably (Kilgore et al. 2007, Greene et al. 2011). Policymakers must explore additional funding options in order to sustain state-level cost-share programs and allow them to function effectively. The demand for cost-share assistance in all but one state in the U.S. South exceeds the supply of available funds. This has limited the accomplishments of state programs for the relatively narrow timber production practices. Limited funding suggests that broadening the existing program objectives without adding new state appropriations or other funding will be difficult.

Some states attribute lack of funding for service foresters as a limitation on the implementation of their state-level programs (NCFS 2019). The literature inside our database, but outside our sample in the U.S. South, identified that landowners highly value technical assistance through service foresters, in some cases more than financial assistance (Bliss and

Martin 1990, Boyd 1984, Kilgore et al. 2007). As such, increasing funding for service foresters may be a useful marketing tool to attract landowners that prefer technical assistance over financial assistance alone.

Continued, consistent funding through appropriations and other sources will ensure states will be able to recognize the positive net benefits from cost-share programs that were reported in the literature (Brooks 1985, Flick and Horton 1981, Koesbandana et al. 2017, Stoots et al. 2017). In fact, three state programs have been discontinued due to a lack of funding, two of which depended on voluntary contributions from forest industry, and two more programs appear to be heading toward discontinuation for the same reason (Haines 1995, Granskog et al. 2002). In addition, five active programs are dependent on the annually variable revenue from taxes on harvested wood products, which causes a degree of uncertainty for program administrators when predicting available funds for the upcoming enrollment period. For this reason, it may be advantageous to complement the variable funding from harvest tax income with fixed funding amounts from other sources such as state appropriations.

Partnerships

Third, a continuation of partnership between funding opportunities with recommended management practices is needed to foster the effects of “gateway programs” (Ma et al. 2012). Each of the state programs in the U.S. South require landowners manage forestland according to management plans approved by the administering agencies. The provisioning of this service should complement, not replace, cost-share payments. Daniels et al. (2010) stated that (1) forest continuity, (2) benefit to the owner, and (3) doing the “right thing” motivate forest management on private non-industrial woodlands. Federal programs also may provide forestry incentives, as discussed shortly. These partnerships can extend the area of and services provided by forests.

State agencies connect these motivations through subsidizing practices correlated with landowner objectives that simultaneously benefit the landowner and public. On the other hand, as state programs prohibit landowners from receiving cost-share reimbursements from multiple sources on the same acres, landowners with limited landholdings may have to choose between sources of landowner assistance. This can be further exacerbated when programs require landowners to meet the constraints of ownership and/or treated acreage. Until more funding opportunities are made available, however, it may be beneficial for program administrators to target landowners who do not qualify for other sources of aid to ensure the inclusion of all landowners in need of assistance. Continued efforts to provide technical assistance and programs with dedicated funding streams for minority and limited income forest landowners remain important.

Ecosystem Services

Increased public recognition of environmental benefits of forests augur for broadening the focus of forest incentive programs to include the provisioning of ecological benefits such as soil and water conservation. Policymakers may refer to the programs in Alabama, Kentucky, and Tennessee for approaches to incorporating and valuing these benefits. Table 2.3 shows that environmental or non-market-related program objectives are not as common as timber production or wildlife objectives. Most state-level cost-share programs in the U.S. South were developed with the support of private forest owners and the forest industry in order to secure a sustainable yield of timber (Haines 1995, Granskog et al. 2002).

The original initiative of North Carolina's Forest Development Program, for instance, was to increase tree cover (NCFS 2019). Administrators remain cognizant of ensuring that the program remains aligned with the interests of the forest products sector, which provides all the

funding through its self-approved voluntary tax on harvested timber. Now, non-industrial landowners and forestry professionals value forests for many market and non-market products and services (Butler et al. 2016). Moving forward, incentive programs should be designed to assist landowners with multiple objectives such as wildlife habitat, biodiversity, water quality, and carbon storage. For example, Kentucky's program covers forestry along with other agricultural practices in order to improve soil and water conservation on working lands.

Substantial increases in state appropriations would be necessary if current programs were expanded or new ecosystem service incentive programs were developed. The broader environmental goals for better water quality, runoff prevention, biodiversity, carbon storage, or other service are widely recognized, and not well provided for by markets. There is increasing public and forest landowner recognition of these services. However, forest commodity interest groups have provided the legislative advocacy for most current southern programs. Thus, it would take those groups to expand their support for more practices or being willing to accept the tradeoff of less state expenditures on traditional forestry expenditures. States have already done this to some extent, with major focus efforts on and larger budget shares for diverse native tree species with longer rotations. But a major shift to non-traditional ecosystem service payments will require new dollars and new political support.

Supplemental Funding

States in the U.S. South supplement cost-share payments from state-level programs with other incentives when available. For example, the Emergency Forest Restoration Program (EFRP), funded through acts of Congress (USDA Farm Service Agency [FSA] 2020), distributed \$2 million in cost-share payments to compensate landowners in Georgia for losses and biomass removal following catastrophic hurricanes and tornadoes in 2017 (Georgia Forestry Commission

2020). Similarly, North Carolina's Florence Reforestation Fund, a state program, allocated \$2.4 million to impacted landowners in 2019 following Hurricane Florence (Cappelletti 2019). These totals, \$2 million and \$2.4 million, are more than the total annual payments from state cost-share programs in five southern states. As we see more impacts of climate change and extreme weather events in coastal states, policymakers may consider adapting current goals to address these immediate concerns and events through state cost-share programs.

Other notable sources of financial assistance include the USDA Forest Service's Southern Pine Beetle Prevention Programs (SPB), collaborations of organizations which promote longleaf pine forests, and partnerships with local wood products industries. The SPB Prevention Project in Mississippi distributed over \$2.4 million in cost-share assistance for thinning activities between 2006 and 2014 (Kushla et al. 2019). The USDA Natural Resources Conservation Service, along with several other organizations, sponsor a longleaf pine incentive program which supported activities on over 400,000 acres of private forests across nine of the southern states between 2010 and 2016 (USDA 2020). As an individual private sector incentive, Huber Engineered Woods (HEW) has donated seedlings to landowners since 1998 to promote reforestation efforts near their operations in Oklahoma, Georgia, Tennessee, and Virginia. HEW's efforts have contributed to tree planting on approximately 8,000 acres in Southeastern Oklahoma since 2005 (Huber 2020).

It is important to note that even with other sources of assistance through incentive policies, local partnerships, and federal programs, demand for cost-share payments remains greater than the available supply of funds. While the existence of these programs may give policymakers cause to reduce funds for state cost-share programs, they should be made available

in addition to state administered assistance in order to fund the applications which would not have received funding otherwise.

Conclusion

This study used qualitative reviews of existing literature and published state, to analyze southern forestry cost-share programs. This evaluation of the past efforts of assistance programs is useful to help address issues meeting diverse goals of these programs and landowners alike. The demand for more goods and services from forests—which often are not provided sufficiently by markets—suggests that better knowledge about forestry incentive programs remains crucial. All these efforts—federal or state—depend in some fashion on providing more financial incentives to establish more forests and on state programs and agencies to implement them. The results of this study could contribute to a regional discussion on the framework of financial assistance programs for landowners in the southern states for reforestation and timber stand improvement, as well as prospects for expansion to the increasingly important ecosystem goods and services. Future studies should continue to build upon this subject to determine how well existing programs are achieving current goals; tradeoffs possible if their objectives were expanded; and opportunities and costs of developing new objectives and new programs to meet the needs of forest landowners and the broader group of stakeholders and citizens in the U.S. South.

Tables and Figures

Table 2.1: Characteristics of selected forest incentive literature in the United States

Study Characteristic	Number of Studies in Database (N=86)	Percent in Database	Number of Studies in Sample (N=21)	Percent in Sample
Southeast U.S.*	38	44%	21	100%
Federal program(s)	62	72%	15	71%
State program(s)*	54	63%	21	100%
Cost-share program(s)*	64	74%	21	100%
Publication decade: 1980s	15	17%	8	38%
Publication decade: 1990s	10	12%	3	14%
Publication decade: 2000s	20	23%	3	14%
Publication decade: 2010s	41	48%	7	33%
Timber production focus	67	78%	16	90%
Tax program(s)	40	47%	8	38%

*Sample inclusion criteria (i.e., state-level cost-share programs in U.S. South)

Table 2.2: Counts of state cost-share program topics explored in the literature sample, categorized by the literature findings*

Literature Topics (Count)	Relationship to State Cost-Share Programs*			Total
	Pos.	Pos. & Neg.	Neg.	
Literature Sub-topics				
Economic/Market (19)				
Reforestation investment	8		1	9
Capital substitution		2	3	5
Net benefits	4			4
Timber production	1			1
Environmental/Non-market (5)				
Sustainable forest management	3			3
Ecosystem services	1			1
Wildlife habitat improvement	1			1
Landowners' Perceptions and Knowledge (15)				
Program participation	1	1	5	7
Compatibility with other policies	1	1	1	3
Landowner awareness	1	1		2
Landowner objectives	1	1		2
Landowner trust			1	1
Total	22	6	11	39

*Whether positively, negatively, or both positively and negatively correlated to state cost-share programs

Table 2.3: State-level cost-share programs in the U.S. South

Program (Year Established)	Program Objective	Eligible Practices	Funding Source	Eligible Owners	Time Required	Size Required	Selection Method	Cost-share Percent/Rate	Annual Treated Acres	Cost-share Paid (million)*
Alabama Agricultural & Conservation Development Commission Program (1985)	Agricultural and timber production	soil conservation, water quality improvement, site preparation, natural regeneration, timber stand improvement, prescribed burning, permanent fire lane construction	Interest on oil and gas windfall trust fund and General State Fund	Private, state, non-federal	5-10 years practices maintained	>20 acres (own), > 1 acre treated	-	<75%	231	-
Arkansas: No state cost-share	-	-	-	-	-	-	-	-	-	-
(1) Florida Reforestation Incentives Program (1981) and (2) FL Plant a Tree Trust Fund Program (1995)	(1) Reforestation on private lands and (2) Urban tree planting and rural reforestation	(1) Seedling purchase and (2) site preparation and tree planting	(1) Voluntary contributions from forest industry and private donors and (2) Gas pipeline company	(1) Private and (2) local governments, Non-profits, private (not publicly traded)	(2) 2 years	(1) Own >10 ac and (2) own 10-1,000 ac	(2) Ranked by management plan, number and size of trees, cost-effectiveness, environmental enhancement, wildlife habitat improvement	(1) 60,000 seedlings max and (2) \$1,000-10,000	-	-
Georgia: No state cost-share	-	-	-	-	-	-	-	-	-	-
Kentucky Soil and Water Quality Cost Share Grant Program (1994)**	Soil and Water protection/improvement	Agriculturally-related soil and water conservation, forestland erosion control systems, riparian area protection	State Pesticide fee, tobacco settlement fund, and state appropriations	Private landholdings with working	5-10 years practices maintained	None	Prioritized by conservation district (agricultural waste control = top); Ranking system based on practices (weighted average of practice value and treatment area)	75%	-	\$ 5.5

Table 2.3 (continued).

Louisiana Forestry Productivity Program (1998)	Establish and improve timber production	Planting, site preparation, timber stand improvement, pre-commercial thinning release	Severance tax		Maintain forestry usage for 10 years	Own 5 contiguous ac suitable for producing valuable timber species	First-come	50%	21,767	\$ 1.8
Mississippi Forest Resource Development Program (1974)	Develop forest economy and enhance wildlife	Tree planting, site preparation, prescribed burning, firebreak construction, forest improvement	Timber Severance tax (80%)	NIPF, non-federal public	10 years maintained	None	First-come	50-75%	31,053	\$ 1.9
North Carolina Forest Development Program (1978)	Timber production and benefits of active forest management	Site preparation, seedling purchase, tree planting, release of seedlings from competing vegetation, forest improvement	50% Timber Severance tax, 50% state appropriations	Industrial and nonindustrial	Practices maintained for 10 yrs	Min 1 ac and Max. 100 acres per practice per yr	Lottery	40-60%	44,574	\$ 1.8
Oklahoma Forest Resource Development Program (1996)	Establishment, management, maintenance, enhancement, restoration of NIPF	-	-	-	-	-	-	-	-	-
South Carolina Forest Renewal Program (1981)	Encourage tree planting on private lands to help ensure sustainable timber supply for the future	Site preparation, tree planting, timber stand improvement, natural regeneration, prescribed burning	Tax on roundwood processed by industry (80%) and State Appropriations	NIPF capable of producing 50+ cubic feet of industrial wood/ac/yr	10 year forest condition maintained	Min. 10 ac. for mechanical site preparation and max 100 ac	Allocation per county is based on its percent value of statewide timber harvests. Applications are funded in the order received After July 1, unfunded applications are funded using slippage funds	40%	11,835	\$ 0.9

Table 2.3 (continued).

Tennessee Agricultural Enhancement Program (2005)	promote long term investments in Tennessee's livestock, farming operations, and forest resources	Hardwood and softwood planting, site preparation, and vegetation control; Forest stand improvement: chemical or mechanical release of competing vegetation, pre-commercial thinning, crop tree release	State General Funds	private individuals; joint owners; corporations (except wood-using industries) without publicly-traded stock; and non-profit organizations and groups		single ownerships of at least 10 acres of forestland, at least 5 contiguous acres, and at least 120 feet in width. Ownership and treatment area size requirements are waived when the treatment area is a riparian zone	Sign-up during May, enough funds to pay all who are eligible	50%	1,050	\$ 0.3
Texas Reforestation Foundation Program (1981)	Increase productivity of NIPF woodlands and ensure sustainable timber supply for the future	Land clearing, site preparation, tree planting, and timber stand improvement	Voluntary assessment on primary forest products (industry)	East TX project on 10 or more acres (treatment)	10 year maintain practice	Own 1,000 max and Project 10 min ac	High ranking to small ownerships, cutover land, and properties with high site indices	50%	-	-
Virginia Reforestation of Timberlands Program (1970)	Pine reforestation	Site preparation, tree planting, competition release	Matching: forest industry (Forest Products Tax) and Commonwealth of VA's General fund	Private (industrial and non-industrial)	10-year practices maintain	1-500 acres (project) unless site prep required then 5+ ac	If the landowner returns a signed application before May 31, the oldest harvested tracts are approved first. Applications received after are approved on a First-come first-served basis	<75%	43,115	\$ 2.5

*Cost-share funds for site preparation, forest establishment, and timber stand improvement activities in one year (year varies by program depending on data availability)

** Cost-share funds aggregated for both agricultural and silvicultural practices

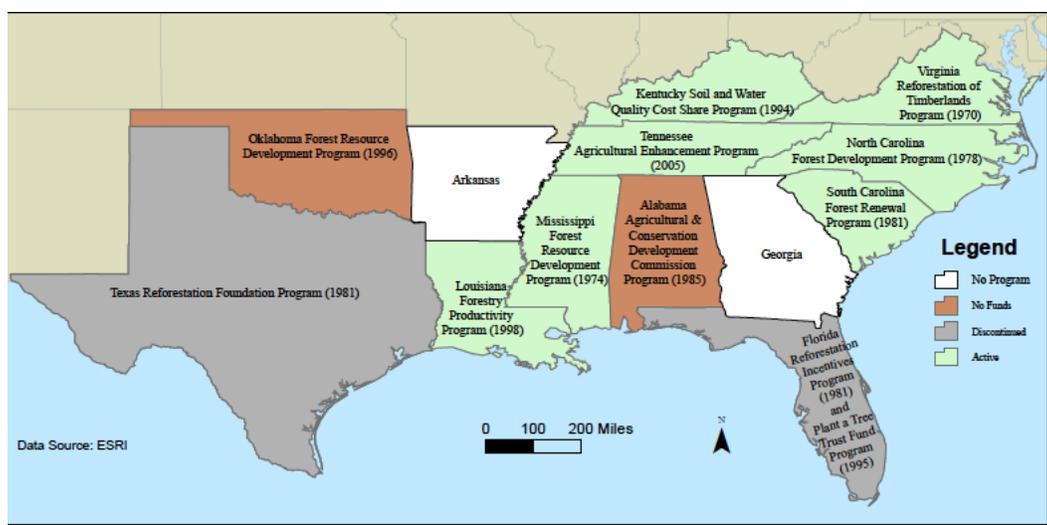


Figure 2.1: A map showing the southern states and corresponding state-level forestry cost-share programs.

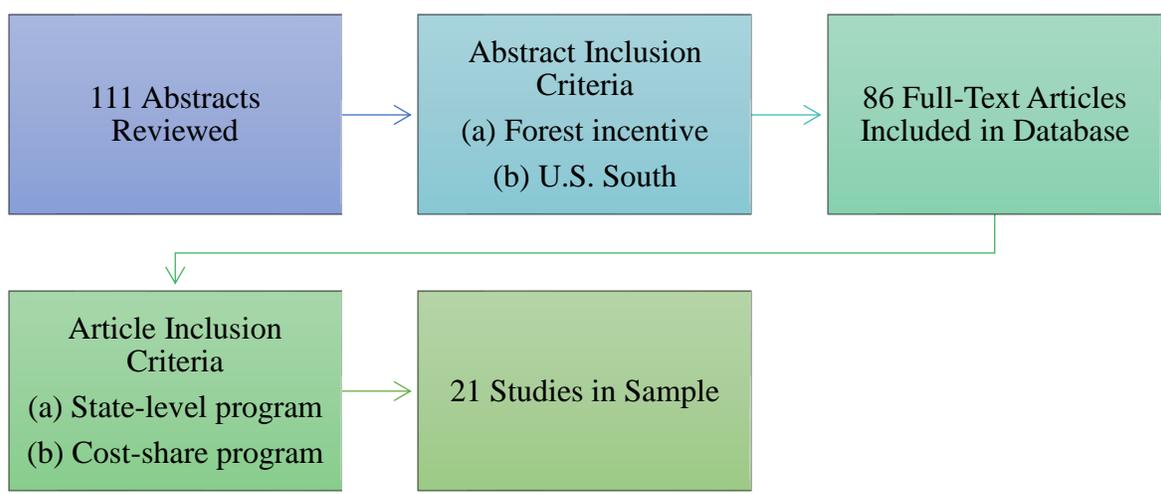


Figure 2.2: Literature Selection Criteria

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**CHAPTER 3: ALLOCATION VERSUS REIMBURSEMENT: FACTORS EXPLAINING
THE DISTRIBUTION OF THE FOREST DEVELOPMENT PROGRAM FUND
IN NORTH CAROLINA**

Abstract

The Forest Development Program (FDP) is the primary state-administered cost-share assistance program for forest landowners in North Carolina. The demand for FDP cost-share funds often exceeds available resources, leading to a fund allocation dilemma for the program administrator, the North Carolina Forest Service (NCFS). Allocating limited funds for reimbursements on the most acres and to the most applicants while accounting for multiple objectives and constraints is a primary issue in administering any public assistance program. While the demand for FDP cost-share funds often exceeds available resources, actual cost-share reimbursements are generally lower than the initially allocated amount, and frequently, applicants cancel their projects entirely. Additionally, implementation rates of completed applications vary due to actual costs and the acres to receive the subsidized treatment. For example, actual costs may be different from the prevailing rates established by the NCFS and the treated acreage may differ from the acreage approved in the application. This study evaluates various factors related to the utilization of allocated funds based on actual cost-share fund usage data from the years 2015 to 2020. Results suggest that FDP applications associated with chemical release treatments (site preparation), pine hand-planting activities, and larger applied acreage values are more likely to be completed and implemented as defined in the initial application. The methods and findings of this study provide useful insight to administrators of public incentive programs.

Keywords: Allocation of public funds; cost-share program; landowner assistance; forest management practices; regression; public policy

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Introduction

Governmental programs in the form of financial incentives to promote natural resource management and conservation are widespread globally. In part, this is a recognition of the fact that many forest ecosystem services are positive externalities; that is, landowners who produce them receive no compensation in private markets, so governmental intervention is justified. For example, governments within the Organization for Economic Co-operation and Development (OECD) spent \$280 billion (USD) in 2005, a major increase from the negligible expenditures in 1986, supporting agriculture, production systems, and environmental services in the form of direct payments and preferential tax programs (Hajkowicz and Collins 2009). Federal financial incentive programs for private forests in the United States (US) averaged \$596 million per year (2015 dollars) from 2010-19 (Frey et al. in press). Governmental funds will be needed to reach socially optimal levels of conservation as long as markets for ecosystem services remain limited with significant barriers to entry.

The underuse of the allocated fund for incentive payments, also known as slippage funds to program administrators, is an inefficiency for providers as they typically cannot be used during that funding period. This is due to the fact that cost-share reimbursements to landowners depend on the actual costs of the practices as well as the number of acres receiving the practice. As such, actual incentive payments in the form of reimbursements are associated with a degree of uncertainty that is important to explore as unused allocations delay or forgo the potential

impacts from financial incentive programs. This occurrence has been documented in the US Environmental Quality Incentives Program (EQIP) and state cost-share programs in Kentucky, South Carolina, and North Carolina (Cattaneo et al. 2003; Chizmar et al. 2021). For instance, approximately 25% to 40% of the yearly budget for North Carolina's Forest Development Program (FDP) is not paid to landowners within the funding period (Figure 3.1) (North Carolina Forest Service [NCFS] 2016, 2017, 2018, 2019b).

In this study, we investigate the past accomplishments of the FDP and which attributes are correlated with the better utilization of allocated cost-share dollars. We evaluate the FDP through four predictive models that explore the factors related to the completion of cost-share funded activities. The modeling framework used in this study may be adapted and applied to other incentive programs to evaluate which characteristics drive their ability to meet their objectives, particularly under a constrained budget.

This study differs from past research by utilizing extensive data of actual cost-share payments, or direct reimbursements to landowners, to analyze relationships among incentive recipients, locations of subsidized activities, and types of practices applied in North Carolina (NC) (de Steiguer 1984; Hardie & Parks 1996; Lee et al. 1992; Royer 1987). We developed and estimated various econometric models based on the FDP data for reforestation, site preparation, and timber stand improvement practices. Prior econometric analyses of the FDP focus primarily on the landowner's decision to invest in reforestation practices to estimate the program's contribution to the wood supply (de Steiguer 1984; Hardie & Parks 1996; Lee et al. 1992; Royer 1987). The historical studies attempted to identify evidence of capital substitution of private investment by public dollars. While subsidizing reforestation efforts that might have occurred without assistance is a consequence of concern for some, capital substitution is relatively

innocuous in its impact on timber prices. For instance, cost-share dollars that do not induce investment in reforestation do not lead to increases in the wood supply, thus keeping timber prices low. As a result, we adapted these frameworks on landowner behavior to instead evaluate decision-making by the cost-share administrator.

The results of this study offer useful insights to public fund administrators managing constrained budgets. The Trillion Trees (2020) mission makes this study especially timely as the intention of the US to double the area of planted forests will require the country, as well other nations, to increasingly rely on forest incentive programs to meet the proposed reforestation goal: Re-grow, save from loss, and better protect one trillion trees around the world by 2050. The organizations strive to achieve the Trillion Trees vision through ending deforestation, improving protection, and advancing restoration of the “right trees in the right places” (Trillion Trees 2020). At the national level, the 2018 Farm Bill was projected to outlay approximately \$60 billion to support both commodity and conservation programs from 2019 until 2023 (USDA Economic Research Service [ERS] 2020). At the state-level in the US, programs such as the FDP will be needed in addition to federal efforts to meet the country’s ambitious goal (Chizmar et al. 2021).

Background: North Carolina’s Forest Development Program

The FDP has supported private investment in forest stand establishment and improvement on over 1.3 million acres since state legislation established the program in 1977 (NCFS 2020). The NC Forest Service (NCFS) administers the FDP as the state’s forestry “gateway program.” Landowners enroll for the financial benefits but learn about water quality and forest health through implementation of recommended management practices (NCFS 2019a). The FDP compensates landowners through direct reimbursements known as cost-share payments (Mehmood and Zhang 2002; Cabbage et al. 2020) to address barriers to investment

efforts such as limited capital and cash flow in the initial years of the investment (Haines 1995, Granskog et al. 2002). The payments increase the profitability of forestland management to make forestry a more equitable investment option compared to alternative land-uses (Haines 1995). Approved applicants are allocated a maximum potential reimbursement based on the acres requested by the landowner and prevailing rates of forest management practices, published annually by the NCFS by district and management intensity. Applicants then have one, preferably, to two years to complete the approved work and follow-up with the NCFS by submitting an invoice for the completed work.

Annually, the FDP provides funds for new site preparation, tree planting, and forest stand improvement projects while continuing to disburse payments for previously approved projects (NCFS 2019a). Beginning in 1987, the administrators of the FDP were authorized to designate a portion of the funding available for cost-share allocations to two special funds for activities (1) that include planting-only, and not site preparation or timber stand improvement, practices and (2) located in the mountain region of North Carolina (NC Division of Forest Resources 2009). Landowners each year may apply for new management projects on at most 100 acres with a maximum reimbursement payment of \$10,000 which was initiated during fiscal year (FY) 2017-2018 (NCFS 2017). Subsidized management activities expanded from tree planting over time to include site preparation strategies and timber stand improvement practices (NC Division of Forest Resources 2009). Table 3.1 presents a timeline of the program history.

FDP's cost-share rate decreased from 60% to 50% on July 1, 1983 and further to 40% on July 1, 1984 to reduce waiting periods for payments and serve more landowners as demand for assistance was greater than the available supply of funds. FY 1984-1985 also saw the inception of maximum prevailing rates which placed a cap on eligible cost-share reimbursements (NC

Division of Forest Resources 2009). This addition changed the reimbursement amount to the lesser of two options, adding another layer of uncertainty: (a) cost-share percentage multiplied by the consumer invoice or (b) the product of the cost-share percentage, prevailing rate of activities, and the practice acreage.

The Great Recession (2007-2009) negatively impacted the US wood products sector through drastic decreases in demand for softwood lumber (Oswalt et al. 2019). Consequently, there were fewer funds from consumption-related taxes and fees to support public programs. Meanwhile, the state's general fund was reduced due to lower sales and income tax and higher payments to safety net programs such as unemployment. The FDP, originally funded through a combination of general state appropriations and a tax on harvested wood products in NC, stopped receiving general state funding after FY 2008-2009, except for a payment in 2016 used to fund the landowner projects on the waiting list. The waiting list was then reinitiated during FY 2018-2019 due to excess demand for cost-share funds (NCFS 2019a). A 2009 FDP Continuation Review Report advised the program requires \$1.4 million in addition to the tax on wood products and unused reserve funds to assist all cost-share applicants (NC Division of Forest Resources 2009). The additional funding is necessary to support the benefits produced by FDP cost-share dollars. For instance, Koesbandana (2017) estimated that the \$4.2 million spent jointly in 2012 by the government and private landowners increased total industry output by approximately \$12.5 million and total value added by almost \$7.5 million.

Methodology

Each pay period, the FDP draws funds from the state-appropriated budget for cost-share reimbursements. The budget formula for the FDP is a collection of three funds on two different cycle schedules: base, tree planting-only, and mountain. For example, for the FY 2019-2020, the

enrollment period for projects paid through the base and mountain funds was March 4 to May 31, whereas the enrollment window for plant-only projects was August 19 to October 18 (NCFS 2019b). Projects in the mountain region of NC, as opposed to the piedmont and coastal plain regions, are funded through the mountain fund first (Figure 2). Landowners that apply for cost-share funds to reimburse tree-planting activities only, not in combination with other management practices, are paid through the plant-only fund first. Site preparation and timber stand improvement projects located primarily in the coastal plain and piedmont regions of the state are paid through the base fund.

Cost-share allocations for management activities are calculated by multiplying the number of acres requested in the application by the prevailing rate of the practice. In past years, FDP cost-share allocations were not fully utilized within the same funding period, delaying approval of other applications for cost-share funds, and thus the forest-based benefits that would have been produced if the cost-share funded activity would have been completed. This is due in part to applicants having one to two years after application approval to complete work, at which time the FDP administrators initiate contact with the applicants for an update. Landowners must report the actual cost and acreage of the work once completed to the NCFS to receive a reimbursement. Therefore, the FDP administrators do not know which applications will be canceled, or will require reimbursements less than the allocations, for one to two years after initial approval. After this period, unused allocations are rolled into the next funding period to be redistributed to new cost-share applicants.

We assumed that the NCFS wishes to maximize the likelihood of funding applications that will be completed (finalized) with the full utilization of the initially allocated amount. We developed the following models to examine the practices and application characteristics that help

explain the better allocation of cost-share payments for their full utilization. Table 3.2 provides a description of the study variables.

Equation 1 models the status of applications, whether finalized or canceled, as a function of the application characteristics, to examine which factors are associated with completed applications (Table 3.2):

$$Finalized = f(Z_i), \quad (1)$$

where $Z_i = base, piedmont, noncorp, CSburn, CSshear, CSbed, CSchemSP, CSpine, CSchem, lnAcre, CS40, YR15, YR16, YR17, YR18, YR19, YR20$. However, it is important to note that the practices in finalized applications may or may not have been completed as specified in the approved application, in terms of treated acreage and the associated per unit costs.

Equation 2 was formulated to capture the implementation rate, or extent of completion, of cost-share funded management practices:

$$CSratio = f(Z_i). \quad (2)$$

The equation relates the application characteristics to the ratio of actual reimbursements to original allocations. The implementation rate, denoted as $CSratio$, modeled in Equation 2 is influenced by the cost landowners were charged to complete approved practices and the number of acres to receive the treatment as allocations and reimbursements are the product of treatment acreage, unitary costs, and the cost-share rate. Consequently, we developed Equations 3 and 4 to separate the multiple influences, costs and acres, on the implementation rates of cost-share funded management practices. Equation 3 regresses the application characteristics on the ratio of actual costs per acre to the approved prevailing rate, $CostRatio$:

$$CostRatio = f(Z_i). \quad (3)$$

Likewise, Equation 4 relates characteristics of applications to *AcreRatio*, the ratio of completed acres to approved acres:

$$AcreRatio = f(Z_i). \quad (4)$$

We only observed the outcome variables in Equations 3 and 4 when applications are finalized as the FDP administrators are unaware of how practices are completed when applicants do not follow-up with an invoice.

The dependent variable in Equation 1, *Finalized*, is a binary variable that equals 1 when an application status is completed or finalized and 0 otherwise. The dependent variable in Equation 2, *CSratio*, is a ratio bounded between 0 and 1, inclusive, which represents total cost-share reimbursements equal to or greater than their originally approved allocations. The ratio equals 0 for total cancellations where no reimbursement is paid, 1 for reimbursements that match their original allocations, and values between 0 and 1 when an applicant received a reimbursement less than the allocation approved in the application. Reimbursements for finalized applications may be less than their allocations if (a) the landowner performed the work on fewer acres than originally approved and/or (b) the landowner paid a lower actual price than the prevailing rate.

We developed two other dependent variables (Equations 3 and 4) in an attempt to separate out the effects of (a) and (b). The outcome variable in Equation 3, *CostRatio*, is a ratio of the actual costs per practice, as reported in applicant invoices, to approved prevailing rates from finalized applications. *CostRatio* data had values between 0 (cancellations or work performed at no cost) and 4.67, inclusive. A value of 1 would suggest that a landowner paid the prevailing rate and those less (more) than 1 signify the landowner paid less (more) than the prevailing rate. Meanwhile, the dependent variable in Equation 4, *AcreRatio*, is a ratio of the

acreage completed by the applicant to the acreage originally approved in their application, taking values inclusively between 0 (cancellations) and 10.0. Landowners may request additional cost-share funding if they underestimate the acreage they are able to treat. The explanatory variables, representing application characteristics, are described in detail below.

Base – Special funds began in 1986 for tree planting-only applications, as applications can have multiple practices, and projects located in the mountain region of NC (NCFS 2020). Remaining resources for cost-share applications are considered base funding. The base fund allocates payments for site preparation and timber stand improvement activities, and planting when combined with site preparation and timber stand activities, primarily in the coastal plain and piedmont regions. The variable, *base*, is a binary variable that equals 1 if an application is funded through the base fund and 0 otherwise.

Piedmont – *Piedmont* equals 1 when the site of the FDP application is located in the piedmont region and 0 when located in either the mountain or coastal plain regions. Projects located in the piedmont, as well as those in the coastal plain, are paid through the base or plant-only funds. Meanwhile, projects in the mountains region may be paid through the mountain, plant-only, and in some cases, the base funds. Many of the regional variables used by Cattaneo (2003) were significant determinants of cost-share program participation and practice withdrawal.

Noncorp – The FDP delineates private forestland as either individually owned or owned by corporations, associations, estates, and trusts. The binary explanatory variable, *noncorp*, equals 1 when the forestland for the FDP application is owned by non-corporate owners, and 0 by corporate owners.

Forestry Practices (CSburn, CSshear, CSbed, CSchemSP, CSpine, CScontain, and CSchem) – We created binary variables for the forestry practices that most commonly apply for FDP funds.

Each respective variable equates to 1 for applications including that management practice, and 0 otherwise. *CSburn*, *CSshear*, *CSbed*, *CSchemSP* refer to site preparation activities: burning, K-G Blade/shearing, double-bedding, and chemical release, respectively. A K-G Blade is mounted to bulldozers to clear sites and split and shear stumps at their bases (Megalos et al. 2018).

CSpine and *CScontain* represent hand-planting of loblolly and containerized longleaf pine seedlings, respectively. Finally, the *CSchem* variable is related to chemical release measures to improve timber stands. We tested for significant differences between each pair of cost-share practice variables following model estimations. Cattaneo (2003) found that water and habitat management practices increased the odds of practice withdrawal, while livestock and crop nutrient practices decreased the odds.

lnAcre – The integer variable *lnAcre* is the log transformation of the number of funded acres according to applications for cost-share reimbursement. Typically, landowners apply for 1 to 100 acres of a subsidized practice per year, although there is one application in the data set which was approved for 105 acres. Cattaneo (2003) found that the variables representing total farmland acreage and crop-share acreage were significantly and positively related to application withdrawal.

CS40 – The binary variable *CS40* denotes the cost-share rate of the applied practices. The variable equals 1 when associated with a 40% cost-share rate and 0 for practices with a 60% cost-share rate. Many of the practices under the 40% category are related to loblolly pine activities. Meanwhile, wetland species, hardwoods, and longleaf pine are characterized by a 60% cost-share rate to make restoration of these species more attractive and equitable to loblolly pine activities (NC Division of Forest Resources 2009). Hardie and Parks (1996) found the proportion

of shared costs to be a significant determinant in pine reforestation behavior on non-industrial private forestland.

Funding year (YR15, YR16, YR17, YR18, YR19, YR20) – We created binary variables to represent each funding year in the study. Variables *YR15, YR16, YR17, YR18, YR19* and *YR20* take on the value of 1 when funded during 2015, 2016, 2017, 2018, 2019, and 2020, respectively, and 0 otherwise. These variables not only capture the year effects but also the changes in the fund allocation method for the 2019-2020 fiscal year, represented by *YR20*. Applications funded prior to *YR20* were selected on a first-come, first-served basis.

Estimation Methods

Model of cancelled versus finalized applications

We performed analysis using Stata version 16.1 (StataCorp 2019). In this study, we estimated Equation 1 via the logit approach since our first equation includes the dependent variable *Finalized*, a binary variable which signifies the application status, whether finalized (1) or canceled (0). Cattaneo (2003) estimated four alternative logit models to determine which characteristics were associated with conservation practice withdrawal from the EQIP. The logit model, a binary response model, is estimated through maximum likelihood. Thus, results were interpreted as the probability of funding a finalized application, a positive outcome from the point-of-view of the NCFPS, subject to our set of regressors and the cumulative logistic distribution. We calculated robust standard error estimates, Huber-White sandwich estimates (StataCorp LLC 2019), for each of the independent variables.

Model of reimbursement ratio

The ratio of reimbursement amount to the initial allocation (*CSratio*) ranges from 0 for total cancellations where no reimbursement is paid to 1 for reimbursements that match their

original allocations, and takes the value between 0 and 1 when an applicant receives a reimbursement less than the initially approved allocation in the application. When estimating such models, a censored normal regression model is theoretically flawed for fractional data and could result in biased and misleading estimates. This is due to the treatment of the conditional mean: the estimated mean of the reimbursement rate conditional on the explanatory variables must also take values between 0 and 1, inclusively (Sauer et al. 2010). Fractional response regression, developed by Papke and Wooldridge (1996), features a dependent variable whose values fall between 0 and 1, and also may equal 0 or 1, notated as $[0,1]$. The fractional response regression-logit approach allowed us to evaluate the factors affecting the FDP reimbursement ratio stated in Eq. 2. The quaslikelihood estimation approach produces consistent parameter estimates and robust standard errors without identifying the true distribution of the model (StataCorp LLC 2019; Sauer et al. 2010).

Models of costs per acre and completed acres

We also estimated two models via the tobit method in an attempt to separate the factors influencing actual reimbursement payments, the NCFS allocation/reimbursement strategy and the landowners' ability to execute management practices as approved by the NCFS. The tobit estimation approach fits models for continuous outcomes where the dependent variable is censored, or only observable within a range of values. For this reason, the tobit model can be specified as a latent regression model where outcomes are only observed within certain limits (StataCorp LLC 2019). Unlike the logit and fractional response-logit in Equations 1 and 2, the tobit model assumes that the error term is normally distributed $\varepsilon \sim N(0, \sigma^2)$.

As applied in this study, the tobit estimation method allowed us to specify observations of canceled applications, outcome variables with values of 0, as unobserved. This can be specified as Equation 5, where a is the lower-censoring limit:

$$y_i^* = \begin{cases} y_i & \text{if } a < y_i, \\ a & \text{if } y_i \leq a. \end{cases} \quad (5)$$

In reality, observations of the outcome variables in the tobit models described in the next paragraph may equate to the censored outcome y_i^* or the uncensored outcome y_i , as the NCFS does not know if approved activities were or were not completed and paid for by landowners with canceled applications. Tobit models are also estimated using maximum likelihood.

The first tobit model estimated in the study, referred to as Tobit model A, includes the dependent variable *CostRatio* which equates to the actual cost per acre that the landowner incurs for the management practice divided by the prevailing rate per acre originally approved by the NCFS. *CostRatio* isolates the relationship between realized costs and the prevailing rates established by the NCFS. However, it is important to note that costs greater than the prevailing rate are bound by the FDP reimbursement decision to pay the lesser of two options: the allocation or the actual costs lower than the allocation. The estimation method censored the 1,785 observations of applications that did not receive a reimbursement payment, represented by values of 0.

Meanwhile, the dependent variable *AcreRatio* in Tobit Model B, relates the management practice treatment acreage completed by landowners to the approved acreage in the application. This ratio allowed us to examine factors associated with projects that do and do not execute the management activities on all approved acres. Applicants may also perform the cost-share funded activity on more acres than approved in their application. The FDP will increase potential payouts when resources are available. Interestingly, Tobit model B left-censored two fewer

observations than Tobit model A, 1,783 observations. This is due to landowners reporting completion of activities at a cost of \$0 (i.e., the landowners performed the work themselves or were not charged for the service).

Data

We obtained the data about FDP applications and reimbursements from the NCFS. The database provided by the NCFS included 9,174 applications funded between fiscal years 2015 and 2020. Application status is classified as either finalized (n = 6,027), cancelled (n = 1,784), or open (n = 1,361). We excluded open applications as we, the researchers, as well as the NCFS are uncertain which will be finalized, and which will be cancelled within the one-to-two-year period following approval. We estimated each of the models excluding years with open applications, represented by *YR18*, *Yr19*, and *YR20* in the study, to test for potential selection bias from purposefully excluding open application and robustness. Results from the restricted dataset, excludes funding years 2018-2020, were analogous to the dataset including observations from the last three funding years. Table 3.3 lists all variables along with their summary statistics. We omitted the variable *YR20* to avoid dummy variable trap and the variable associated with hand-planting of longleaf pine seedlings, *CScontain*, after testing for multicollinearity among variables.

Results

Of the 7,811 finalized and cancelled applications, 1,932 applications are funded in 2015; 1,191 applications in 2016; 1,440 applications in 2017; 1,187 applications in 2018; 1,317 applications in 2019; and 742 applications in 2020. Applications, both finalized and cancelled, average 43 acres per applied practice. The six management practice variables capture activities on 5,894 applications. This includes 974 burning practices, 322 K-G blade/shearing activities,

253 double-bedding practices, 1,319 chemical release (site preparation) treatments, 3,101 pine hand-planting practices, and 412 chemical release (timber stand improvement) treatments.

Reimbursements for 6,785 applied practices are requested by non-corporate landowners. The remaining 1,026 applications for forest management practices are associated with corporate landowners. Most applications are finalized or cancelled within the same funding period ($n = 7,714$); however, 94 and 3 applied practices received a one-year and two-year extensions, respectively. Allocations for cancelled and finalized applications average \$1,900 per applied practice, whereas payments for finalized applications are \$1,583 per applied practice on average.

The mean of the dependent variable *Finalized* (0.77) indicates that on average, 77% of applications are completed or finalized and the remaining 23% are canceled, whereas the mean of the dependent variable *CSratio* (0.61) suggests that on average, reimbursements amount to 61% of total allocations. Furthermore, the mean of the outcome variable *CostRatio* (0.77) suggests that on average, actual costs are less than the prevailing rates approved by the NCFS. Lastly, the mean of the dependent variable *AcreRatio* (0.86) implies that on average, 86% of approved acres receive the proposed treatment. Table 3.4 displays each variable along with their estimated coefficients and robust standard errors for each of the four models. Table 3.5 presents the marginal effects for the coefficients estimated using the logit and fractional response-logit approaches. This is needed to measure the magnitude of the change in the dependent variable due to an incremental change in an independent variable.

Logit Model (Finalized)

The estimated coefficients for each of the independent variables in Equation 1 are interpreted as the relationship between the characteristics and finalized applications (Table 3.4). The following factors are positively associated with the likelihood of a funded application being

finalized: piedmont region; K-G Blade/shearing, double-bedding, chemical release (both site preparation and timber stand improvement), and pine hand-planting activities; and the applied acreage (log transformation). We interpret positive coefficients of binary variables as having higher probabilities than each variable's alternative value of funding applications that will be completed. For example, the positive sign on the Piedmont region variable signifies that applications from the Piedmont are more likely than applications from the Mountains and Coastal Plain to be finalized.

Conversely, the subsequent characteristics are negatively correlated with the likelihood of a funded application being finalized: base-fund; non-corporate landowners; burning activities; 40% cost-share rate; and applications funded between 2015 and 2017. The negative sign on the variable *noncorp* implies that non-corporate landowners are less likely than corporate landowners to finalize applications. The 2018 and 2019 funding-year variables are not significantly different from the base year 2020. The magnitude of the marginal impacts on *finalized*, in absolute terms, range from 4% to 15% for the significant determinant variables (Table 3.5). For instance, any applications from the piedmont region, as opposed to the other two regions, would increase the likelihood of funding finalized applications by 6%, whereas applications using the base-fund would decrease the probability of utilizing the allocated fund by 13%.

Fractional Response Regression Model (CSratio)

The variables signifying the piedmont region, hand-planting of pine species, and the site preparation practices modeled outside of burning (K-G blade/shear, double-bedding, and chemical release) are more likely than their respective alternatives to be related to applications that will be fully implemented (Table 3.4). The variable associated with the number of approved

acres (logarithmic scale) also is positively correlated with the dependent variable *CSratio*. On the other hand, the variables representing applications associated with the base fund; non-corporate landowners; burning for site preparation; a 40% cost-share rate; and the 2015, 2016, and 2017 funding years are all negatively related to *CSratio*. The variables signifying chemical release for timber stand improvement (*cschem*) and the 2018 and 2019 funding years are insignificant moderators with respect to the base practice and year variables. The magnitude of the estimated marginal effects associated with the significant factors range from 5% to 18% in absolute terms (Table 3.5).

Tobit Model A (CostRatio)

Similar to the results from the fractional response-logit estimation of Equation 2, the variables associated with the piedmont region; K-G blade/shearing, double-bedding, chemical release (site preparation), and pine hand-planting activities; and the log transformation of the applied and allocated acreage are positively associated with the ratio of realized unitary costs to the approved prevailing rates (Table 3.4). Likewise, the variables inversely related to *CSratio* are also negatively correlated with *CostRatio*: *base*, *noncorp*, *CSburn*, *CS40*, *YR15*, *YR16* and *YR17*. We interpret the coefficients estimated using the tobit approach similar to the results from ordinary least square regressions. For example, an approved application located in the piedmont region, as opposed to the other two regions in NC, increases the expected uncensored realized cost: prevailing rate ratio by 0.08 or 8% (Table 3.4). The estimated coefficients range in magnitude from 8% to 30% in absolute terms. The variables representing chemical release for timber stand improvement and applications funded in 2018 and 2019 are not significantly different.

Tobit Model B (AcreRatio)

Results from the tobit estimation of Equation 4 suggest that *AcreRatio* is positively associated with the variables representing the piedmont region, chemical release activities (both site preparation and timber stand improvement), pine hand-planting practices, and the log transformation of applied acreage (Table 3.4). The completed: applied acre ratio is negatively related to the variables signifying the base fund, non-corporate landowners, burning treatments, a 40% cost-share reimbursement rate, and the 2015, 2016, and 2017 funding years. In absolute terms, the values of the coefficients range from 6% to 28%. *CSshear*, *CSbed*, *YR18* and *YR19* are not significantly different.

Pairwise Comparison of Cost-Share Practices

Table 3.6 displays the results from testing the null hypothesis that the difference between the coefficients on the cost-share practice variables listed under the “Term 1” columns are not significantly different from the estimated coefficients on the practice variables listed under the “Term 2” column. Applications for burning site preparation activities are significantly less likely than applications featuring the other cost-share practices evaluated in the study to be finalized and fully utilize allocations. Meanwhile, K-G Blade/shearing and double-bedding site improvement activities are more likely than chemical release (TSI) treatments to fully implement allocations but less likely than chemical release (SP) and pine hand-planting practices. Interestingly, chemical release (SP) activities are more likely than pine-hand planting activities to be finalized and implemented on at least the applied acreage. However, chemical (SP) practices are less likely than pine hand-planting practices to fully utilize allocations due to costs that are less than the prevailing rates on average. Chemical release (SP) activities are more likely to be finalized and fully utilize allocations compared to chemical release (TSI) activities. Lastly,

pine hand-planting practices are more likely than chemical release (TSI) to fully utilize allocations and pay at the least the prevailing rate.

Discussion

Activities that are funded through the FDP base fund include mainly site preparation and timber stand improvement activities in the coastal plain and piedmont regions. Base-funded applications may also include (1) planting practices when they are combined with other management activities and (2) practices in the mountain region (i.e., when there are no available resources in the mountain fund). Results from the estimated models suggest that practices funded through the base fund are less likely than those financed through special funds to be finalized and reimbursed as specified in the approved application. This could be due to the types of activities as well as the number of activities in each application funded through the base fund. A subsequent analysis should group applied practices by application to separate this impact from the funding source and the activities covered under each fund.

Our results also indicate that project applications located in the piedmont region are more likely than those in the coastal plain and mountain regions to be finalized and receive reimbursements that match allocations. Likewise, applications from the piedmont region are expected to include a higher cost: prevailing rate ratio and a higher completed: applied acre ratio than those from the other regions. The contrasting findings may be due to the variables. For example, *piedmont* equals 0 for both the coastal plain and mountain regions, whereas *base* equals 0 for the two special funds: tree-planting only and mountain. We estimated alternative models replacing the base fund variable with dummy variables representing (a) plant-only projects and/or (b) applications paid through the mountain fund. We also estimated models which replaced the piedmont region variable with dummy variables representing (a) projects

located in the coastal plain and/or (b) applications from the mountain region. The alternative estimated models provide fewer significant coefficients than the models presented in this study.

Administrators of the FDP allocated \$500,000 for plant-only projects, \$250,000 for applications in the mountain region, and almost \$1.3 million to base fund projects for FY 2017-2018 (NCFS 2017). Plant-only projects constituted slightly less than one-half of all projects on approximately one-fourth of all treated acres during that funding period (NCFS 2018). Clustering the variance of applied practices by application when estimating an alternative model may help untangle the effects of the variables representing the base fund and the piedmont region. This would allow us to control for the effect of landowners applying for more than one practice in order to model their ability to execute each additional cost-share funded practice with respect to the region of the application, the activity-related funds, and other characteristics.

In addition, our results suggest that non-corporate landowners, including individuals, estates, trusts, and LLC., are less likely than corporate landowners to finalize their applications and receive full reimbursements. One could argue that corporations should not receive financial assistance, such is the case for certain state-level cost-share programs for forest landowners in the U.S. South (Chizmar et al. 2021). In actuality, corporate landowners with extensive forestland acreage may not be as attracted to apply for cost-share assistance for activities on at most 100 acres or which total to at most \$10,000 per year. Conversely, one could advocate for the inclusion of corporations in programs similar to the FDP which has been funded solely through the forest industry for the last several years.

When decomposing the implementation of cost-share applications, our estimations indicate that non-corporate landowners typically pay a cost lower than the prevailing rate and complete fewer acres than allocated. While lowering the prevailing rates is a potential remedy to

align reimbursements with their allocations as well as spread the limited funds across more applications, the action may also negatively influence the execution of cost-share practices, in terms of acreage. As non-corporate forest landownerships constitute the majority of private forestland in NC, (Oswalt et al. 2019) the FDP administrators may want to assess the rates or payments non-corporate landowners are willing to accept before canceling or not fully executing a cost-share application.

Corporate landowners are often more organized and have increased access to professional foresters as well as seasonal labor for forestry practices due to the economies of scale (Callaghan et al. 2019). We attempted to control for economies of scale through the inclusion of the variable *lnAcre*. The results from the variable representing the log transformation of applied acreage suggest that higher acreage is correlated with a higher probability of funding a finalized application and receiving reimbursements that align with their allocations. The increased likelihood can be attributed to the impact of the *lnAcre* on *CostRatio* and *AcreRatio*: 1% increases in *lnAcre* increases *CostRatio* by 8% and *AcreRatio* by 10% (Table 3.4). A survey of the landowners in the data set could provide the data needed to estimate models with proxies representing access to professional foresters and seasonal labor. The FDP application could also include an additional field, or two, to inquire about scale-related factors. This would help the FDP administrators understand elements related to economies of scale that lead to discrepancies between non-corporate and corporate landowners.

Burning practices are the only activities included in the study that are significantly and negatively related to each of the four dependent variables. The other cost-share practice variables, when significant, are positively related to the outcome variables in Equations 1 through 4. Burning activities are associated with a lower likelihood than other management

activities to be finalized and to be implemented as specified in the application. Burning activities are also correlated with costs that are less than the prevailing rates as well as completed acreage that is less than the allocated acreage. Prescribed burning in forest management, when done under improper conditions, carries the risk of harm and danger to the forest, nearby properties and structures, and human lives. Poor weather conditions for a controlled burn and a lack of capacity to safely apply fire has been documented in the literature to impede implementation of controlled burning (Parajuli et al. 2019).

Similarly, practices associated with a 40% cost-share rate are significantly and negatively correlated with each of the four dependent variables. Thus, this class of management practices are less likely than the 60% class to be finalized and implemented as stated in the application. Activities with a 40% cost share rate are expected to feature costs that are 19% less than the prevailing rate and completed acreage that is 9% less than the applied acreage, on average (Table 3.4). The 40% cost-share rate primarily includes loblolly pine activities, whereas the 60% cost-share rate typically covers hardwood and wetland species practices. Conifers in NC typically perform better than hardwood species on lower-quality soils (Megalos et al. 2019). The performance and economic returns of different species relative to soil characteristics and required management could help explain the discrepancy in the execution of cost-share practices with a 40% rate from those with a 60% rate. Alternative model estimations may include various interaction variables consisting of species-specific practice variables with the cost-share rate variable; however, high correlation among the practice variables with the cost-share rate variable is possible.

The year variables representing 2015, 2016, and 2017 are associated with a lower probability than those in 2020 of funding finalized applications that fully implement their

allocation. It is important to re-estimate the models in one year with a current dataset to determine if these trends remain after applications funded during FY 2020 reach their two-year limit. In addition to year effects, the negative value of the coefficient may indicate that applications funded on a first-come, first-served basis are less likely than those funded through the lottery system to be finalized and fully utilize the allocated funds. Projects approved on a first-come, first-served basis are associated with the 2015, 2016, 2017, 2018, and 2019 funding-year variables. Kilgore et al. (2007) recommended that administrators of federal cost-share programs fund prospective applications according to their expected environmental and economic benefits, as opposed to distribution on a first-come, first-served basis or a lottery system, to improve effectiveness of incentive programs. Nonetheless, evidence on the U.S. Conservation Reserve Program suggests that payments allocated according to their contributions to environmental quality may not achieve environmental benefits at the lowest cost (Perez 2008).

Conclusion

The NC FDP has provided landowners with cost-sharing funds since its inception in the late 1970s. Over time, the program expanded from its roots in reforestation to include stand improvement activities such as site preparation and timber management. The program continues to attract more demand for funds than can be supplied by the wood products tax assessment. Program administrators are interested in adapting the program to maximize the number of acres subsidized within the present budget constraints. Past studies reported that compensation payments for conservation practices should be linked to where consumption occurs, and thus, where taxes and fees accrue (Thomas and Zaporozhets 2017; Liu et al. 2011). In 2019, FDP administrators began weighting allocations to districts in NC according to their contributions to the tax assessment on harvested wood products and selecting prospective applications through

lottery systems (one in each district). This study provides observations on application characteristics such as location to aid program administrators in decision-making and adaptive management.

Specifically, this study sought to identify the factors that explain the variation in the completion of cost-share funded activities utilizing application data from the NCFS, the program administrators of the FDP. We estimated four models to accomplish this. First, we modeled application status, whether finalized or canceled, to determine characteristics correlated to project completion. However, completed practices may not be executed as specified in the application. Thus, we estimated a logit fractional response regression model second to explore the factors related to higher implementation rates, in terms of costs and acres. The third and fourth models then were estimated using a tobit approach to separate the two influences affecting implementation rates.

Our results suggest that the following characteristics increase the likelihood of funding activities that will be completed on all intended acres and at costs that are at least the prevailing rates: the piedmont region, chemical release (site preparation) activities, pine hand-planting practices, and larger applied acreages. Conversely, findings from the four estimated models indicate that projects associated with the following factors are expected to have lower rates of completion and implementation due to costs less than the prevailing rate and fewer completed than applied acres: base fund, non-corporate landowners, burning practices (site preparation), activities with a 40% cost-share rate, and applications funded between 2015 and 2017. Therefore, the NCFS should consider the findings from this analysis when administering the FDP fund.

It is important to note that all binary variables are interpreted in terms of their alternative values. For instance, the coefficients on the 2015, 2016, and 2017 funding year variables imply

that applications funded between 2015 and 2017 are less likely than those funded in 2020 to be completed and implemented as specified in applications. More observations following the transition to lottery-based allocation strategies are needed to determine the impact of the decision on the completion and implementation of cost-share funded practices.

Nations around the world have enacted policies that support the production of environmental goods and services since the environmental movement of the 20th century. Accordingly, governments and donor institutions require greater attention and understanding of the effects of these programs for accountability and adaptive management purposes. Program evaluations of incentive policies, such as the analysis performed in this study on underused cost-share funds, provide frameworks for assessing the performance of the program, which is especially crucial under a constrained budget situation (Keene and Pullin 2011). The forest cost-share programs of the US South have traditionally acted as model policies for the nation (Mehmood and Zhang 2002), and the analysis performed in this study may be also applied to evaluate other public incentive programs for natural resource conservation and management.

Tables and Figures

Table 3.1: Forest Development Program timeline.

Fiscal Year	Description
1979	First year of Forest Development Program and beginning of waiting list
1984	Trial for “tree planting only” special allocation and decreased cost-share rate to 50%
1985	Decreased cost-share rate again to 40% and established maximum prevailing rates
1987	Special allocations allotted permanently for “plant-only” and Mountain region projects
1992	No state appropriations
1993	No state appropriations
1994	Cost-share rates for longleaf pine, hardwoods, and wetland species increased to 60%
2007	Non-recurring special allocation of \$600,000
2008	Funding for forest stand improvement practices available for request
2009	Last year of state appropriations
2017	One-time allocation of \$75,000 and unused reserve funds pay-off waiting list
2019	Waiting list reinitiated and moved to lottery-based distribution
2020	First year of lottery and allocations weighted by district economic distribution

Table 3.2: List of variables with descriptions

Variable	Description
Dependent	
<i>Finalized</i>	Binary variable: equals 1 when the status of an application is final, or completed, and 0 for canceled
<i>CSratio</i>	The ratio of cost-share funds reimbursed to allocated funds, takes values [0, 1]
<i>CostRatio</i>	The ratio of actual labor costs to NCFS prevailing rates, takes values [0, 4.67]
<i>AcreRatio</i>	The ratio of completed acres to applied acres, takes values [0.03, 10]
Independent	
<i>Base</i>	Binary variable: equals 1 for applications paid through the base fund and 0 for applications paid through special allocations
<i>Piedmont</i>	Binary variable: equals 1 for applications in the piedmont region and 0 for applications in the coastal plains and mountain regions
<i>NonCorp</i>	Binary variable: equals 1 for non-corporate landowners and 0 for corporate landowners
<i>CSburn</i>	Binary variable: equals 1 for burning activities and 0 otherwise
<i>CSshear</i>	Binary variable: equals 1 for K-G, V-Blade Shear activities and 0 otherwise
<i>CSbed</i>	Binary variable: equals 1 for double-bedding activities and 0 otherwise
<i>CSchemSP</i>	Binary variable: equals 1 for chemical site preparation activities and 0 otherwise
<i>CSpine</i>	Binary variable: equals 1 for pine hand-planting activities and 0 otherwise
<i>CScontain</i>	Binary variable: equals 1 for hand-planting of containerized longleaf and 0 otherwise
<i>CSchem</i>	Binary variable: equals 1 for chemical release activities and 0 otherwise
<i>lnAcre</i>	Integer variable that is the log transformation of the number of acres allocated cost-share funds
<i>CS40</i>	Binary variable: equals 1 for projects with 40% cost-share rate and 0 for projects with 60% cost-share rate
<i>YR15</i>	Binary variable: equals 1 for applications funded in 2015 and 0 otherwise
<i>YR16</i>	Binary variable: equals 1 for applications funded in 2016 and 0 otherwise
<i>YR17</i>	Binary variable: equals 1 for applications funded in 2017 and 0 otherwise
<i>YR18</i>	Binary variable: equals 1 for applications funded in 2018 and 0 otherwise
<i>YR19</i>	Binary variable: equals 1 for applications funded in 2019 and 0 otherwise
<i>YR20</i>	Binary variable: equals 1 for applications funded in 2020 and 0 otherwise

Table 3.3: Summary statistics of all variables

Variable	Mean	Std. Dev.	Min	Max
Dependent				
<i>Finalized</i>	0.77	0.42	0	1
<i>CSratio (Reimbursement: Allocation)</i>	0.60	0.36	0	1
<i>CostRatio (Actual cost: Prevailing rate)</i>	0.77	0.49	0	4.67
<i>AcreRatio (Completed: Applied Acres)</i>	0.67	0.41	0	10
Independent				
<i>Base</i>	0.71	0.46	0	1
<i>Piedmont</i>	0.64	0.48	0	1
<i>NonCorp</i>	0.87	0.34	0	1
<i>CSburn</i>	0.06	0.24	0	1
<i>CSshear</i>	0.04	0.20	0	1
<i>CSbed</i>	0.03	0.18	0	1
<i>CSchemSP</i>	0.17	0.37	0	1
<i>CSpine</i>	0.40	0.49	0	1
<i>CScontain</i>	0.04	0.19	0	1
<i>CSchem</i>	0.04	0.20	0	1
<i>LnAcre</i>	3.50	0.78	0	4.65
<i>CS40</i>	0.94	0.23	0	1
<i>YR15</i>	0.25	0.43	0	1
<i>YR16</i>	0.15	0.36	0	1
<i>YR17</i>	0.18	0.39	0	1
<i>YR18</i>	0.15	0.36	0	1
<i>YR19</i>	0.17	0.37	0	1
<i>YR20</i>	0.09	0.29	0	1

Table 3.4: Regression results

	(1) Logit – Finalized	(2) Fracreg Logit – Csratio	(3) Tobit A– CostRatio	(4) Tobit B– AcreRatio
Base	-0.83*** (0.08)	-0.37*** (0.05)	-0.13*** (0.02)	-0.12*** (0.02)
piedmont	0.39*** (0.07)	0.27*** (0.04)	0.08*** (0.02)	0.09*** (0.01)
Noncorp	-0.25** (0.09)	-0.23*** (0.05)	-0.08*** (0.02)	-0.06*** (0.02)
Csburn	-0.95*** (0.12)	-0.83*** (0.09)	-0.30*** (0.04)	-0.28*** (0.04)
Csshair	0.37* (0.15)	0.39*** (0.10)	0.13** (0.04)	0.06 (0.03)
Csbed	0.37* (0.16)	0.35** (0.11)	0.11* (0.05)	0.06 (0.04)
cschemsp	0.77*** (0.10)	0.38*** (0.06)	0.12*** (0.02)	0.15*** (0.02)
Cspine	0.57*** (0.08)	0.59*** (0.05)	0.22*** (0.02)	0.11*** (0.02)
Cschem	0.46*** (0.14)	-0.00 (0.08)	-0.05 (0.03)	0.13*** (0.03)
Lnacre	0.42*** (0.04)	0.28*** (0.02)	0.08*** (0.01)	0.10*** (0.01)
cs40	-0.45*** (0.13)	-0.48*** (0.09)	-0.19*** (0.04)	-0.09** (0.03)
yr15	-0.59*** (0.12)	-0.49*** (0.07)	-0.13*** (0.02)	-0.12*** (0.02)
yr16	-0.66*** (0.13)	-0.49*** (0.07)	-0.13*** (0.03)	-0.12*** (0.02)
yr17	-0.92*** (0.13)	-0.67*** (0.07)	-0.18*** (0.03)	-0.20*** (0.02)
yr18	-0.21 (0.14)	-0.12 (0.07)	-0.01 (0.02)	-0.03 (0.02)
yr19	-0.06 (0.13)	-0.05 (0.07)	0.00 (0.02)	0.00 (0.02)
Constant	0.98*** (0.22)	0.28* (0.14)	0.71*** (0.05)	0.45*** (0.04)
N	7811	7811	7811	7811

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Binary variables, alternative representations: special funds; coastal plain and mountain regions; corporate landowners; other management practices; 60% cost-share rate; 2020 funding year

Table 3.5: Marginal analysis

	(1) Logit - Finalized	(2) Fracreg Logit - Csratio
Base	-0.13*** (0.01)	-0.08*** (0.01)
Piedmont	0.06*** (0.01)	0.06*** (0.01)
Noncorp	-0.04** (0.01)	-0.05*** (0.01)
Csburn	-0.15*** (0.02)	-0.18*** (0.02)
Csshear	0.06* (0.02)	0.09*** (0.02)
Csbed	0.06* (0.03)	0.08** (0.02)
Cschemsp	0.12*** (0.02)	0.08*** (0.01)
Cspine	0.09*** (0.01)	0.13*** (0.01)
Cschem	0.07*** (0.02)	-0.00 (0.02)
Lnacre	0.07*** (0.01)	0.06*** (0.01)
cs40	-0.07*** (0.02)	-0.11*** (0.02)
yr15	-0.09*** (0.02)	-0.11*** (0.02)
yr16	-0.10*** (0.02)	-0.11*** (0.02)
yr17	-0.15*** (0.02)	-0.15*** (0.02)
yr18	-0.03 (0.02)	-0.03 (0.02)
yr19	-0.01 (0.02)	-0.01 (0.02)

Standard errors in parentheses
 * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3.6: Linear differences between estimated coefficients on cost-share practice variables

Term 2	Model	Term 1				
		CSburn	CSshear	CSbed	CSchemSP	CSpine
CSshear	1	-0.21*** (0.03)				
	2	-0.27*** (0.03)				
	3	-0.43*** (0.05)				
	4	-0.34*** (0.04)				
CSbed	1	-0.21*** (0.03)	0.00 (0.03)			
	2	-0.26*** (0.03)	0.01 (0.03)			
	3	-0.41*** (0.06)	0.03 (0.05)			
	4	-0.34*** (0.05)	0.00 (0.04)			
CSchem- SP	1	-0.27*** (0.02)	-0.06* (0.02)	-0.06* (0.02)		
	2	-0.27*** (0.02)	0.00 (0.02)	-0.01 (0.02)		
	3	-0.42*** (0.04)	0.01 (0.04)	-0.02 (0.04)		
	4	-0.43*** (0.03)	-0.09** (0.03)	-0.09* (0.04)		
CSpine	1	-0.24*** (0.02)	-0.03 (0.02)	-0.03 (0.03)	0.03* (0.01)	
	2	-0.31*** (0.02)	-0.04* (0.02)	-0.05* (0.02)	-0.05*** (0.01)	
	3	-0.53*** (0.04)	-0.09* (0.04)	-0.12** (0.04)	-0.10*** (0.02)	
	4	-0.39*** (0.03)	-0.05 (0.03)	-0.05 (0.04)	0.04* (0.02)	
CSchem	1	-0.22*** (0.02)	-0.01 (0.03)	-0.01 (0.03)	0.05* (0.02)	0.02 (0.02)
	2	-0.18*** (0.02)	0.09*** (0.02)	0.08** (0.03)	0.09*** (0.02)	0.13*** (0.02)
	3	-0.26*** (0.05)	0.18*** (0.04)	0.15** (0.05)	0.17*** (0.03)	0.27*** (0.03)
	4	-0.41*** (0.04)	-0.07 (0.04)	-0.07 (0.04)	-0.02 (0.03)	0.02 (0.03)

Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

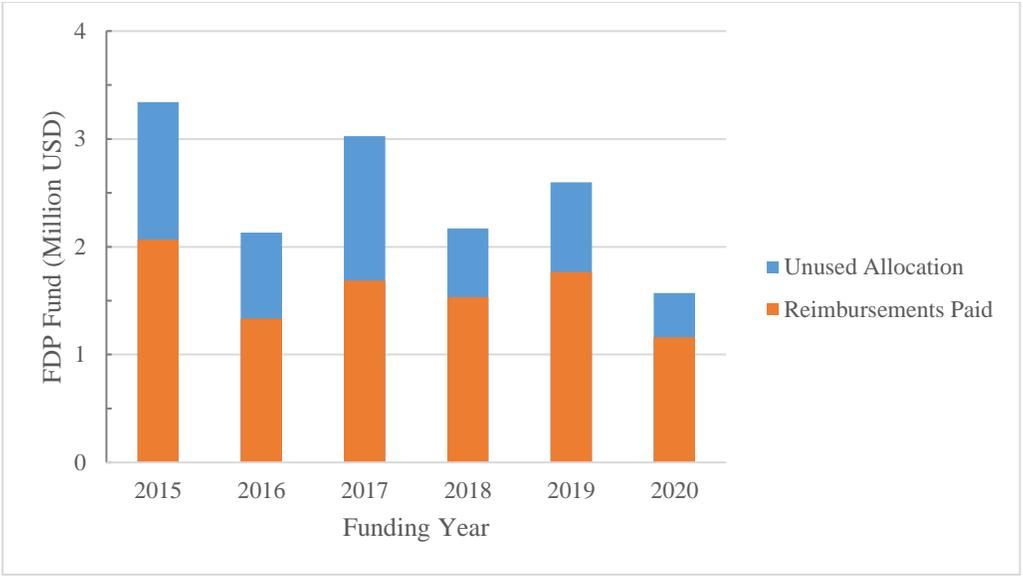


Figure 3.1: Forest Development Program reimbursements and unused allocations

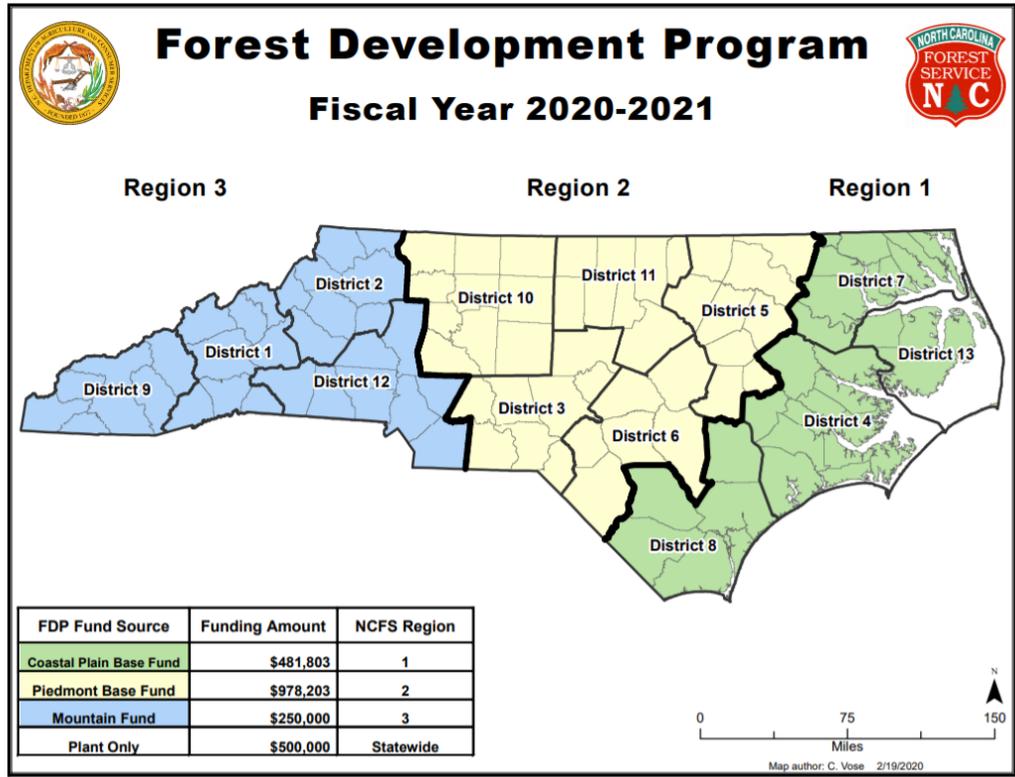


Figure 3.2: Map of North Carolina (Source: North Carolina Forest Service, https://ncforestsservice.gov/Managing_your_forest/pdf/FY_2020-21_FDP_MEMO.pdf)

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**CHAPTER 4: CHALLENGES AND OPPORTUNITIES FOR AGROFORESTRY
PRACTITIONERS TO PARTICIPATE IN STATE PREFERENTIAL PROPERTY TAX
PROGRAMS FOR AGRICULTURE AND FORESTRY**

Abstract

All 50 states offer preferential property tax programs that lower the taxes paid on enrolled agricultural and/or forest lands. While agroforestry is a land-use that combines elements of both agriculture and forestry, eligibility criteria and other rules and regulations may prevent landowners from enrolling agroforestry practices in one or more of the agricultural and forestry tax programs. This study identifies the current barriers to and opportunities in preferential tax policies applicable to agroforestry practices in five pilot states across the United States: North Carolina, Nebraska, Wisconsin, New York, and Oregon. We conducted an extensive review of state preferential property tax programs relevant for agroforestry practices, following focus group discussions with regional experts. Based on a systematic review of statutes and their supporting documents, we developed a database of programs which support or prevent enrollment by agroforestry practitioners. We found that agricultural tax assessments were more likely to favor multi-use agriculture and forestry systems than the preferential tax assessments of forest lands in the five states. Forest farming and alley cropping, followed by silvopasture, windbreaks, and riparian forest buffers, were found to be the most common agroforestry practices allowed under preferential tax classifications in the study states. Programs in the states investigated without strict acreage, income, and productivity requirements generally favor agroforestry practices.

Keywords: agroforestry practices; agroforestry economics; landowner incentives; natural resource policy

Chizmar S, Parajuli R, Frey G, Bardon R, Branan A, MacFarland K, Smith M, and Ameyaw L. (in review). Challenges and opportunities for agroforestry practitioners to participate in state preferential property tax programs for agriculture and forestry. *Agroforestry Systems*, in review.

Introduction

Market conditions and regulatory policies related to taxation, investment, trade, and financial assistance are the major determinants collectively influencing sustainable private land management investments (Ellefson et al. 2005; Cubbage et al. 2020). Preferential property tax treatment of private rural lands in the United States dates back over a century but gained momentum in the mid-20th century (England 2012). Each of the 50 states offer preferential property tax programs (PPTP) which defer, reduce, or eliminate the taxes paid on enrolled agricultural and/or forest lands (Kilgore et al. 2017; Frey et al. 2019). Lands not enrolled in PPTP pay taxes based on a property's fair market value (FMV), a valuation which reflects the highest-best use of comparable properties in a region.

PPTP have helped to influence forest stewardship, encourage the production of timber and non-timber products and services, and delay conversion of rural lands by restoring the balance between a property's taxable value and its income-producing potential (Granskog et al. 2002; Meier et al. 2019). Anderson and England (2015) estimated that agricultural lands enrolled in use-value assessment programs experience significant tax savings compared to lands not under preferential assessment. For example, Ohio's Agricultural Use-Value Program reduced land valuations to 15-25% of the average market value in selected counties (Anderson and England

2015). In addition, forestry programs can reduce taxes by \$8 per acre per year on average across the United States (U.S.), and much more in many states (Kilgore et al. 2017).

Agroforestry is the intentional integration of trees or shrubs with crop and animal production to create environmental, economic, and social benefits (U.S. Department of Agriculture [USDA] 2021; Schoeneberger et al. 2017). Agroforestry practices are commonly believed to provide greater environmental services than agricultural monocultures, reduce risks related to monoculture crop yield and price, and favor enhanced long-term site productivity and soil protection (Zomer et al. 2016; Bentrup et al. 2018; Chizmar et al. 2020).

In addition, agroforestry has been found to benefit forestry systems by reducing income risks, increasing forest management, and reducing impacts on native plant populations (Food and Agriculture Organization 2020). The integration of trees into agricultural systems has also been found to benefit livestock systems. For example, livestock windbreaks have been found to increase yields, provide protection during inclement weather, extend forage opportunities, provide visual screening, reduce odors, and provide shade (Smith et al. 2021). Agroforestry strategically placed may reduce odor transfer from livestock operations, resulting in reduction of social conflict (Tyndall and Colletti 2007), which itself may reduce the incidence of nuisance litigation against such operations (Tyndall 2009).

State PPTP for forest and agricultural lands may preclude agroforestry adopters from potentially crucial tax savings, which by and large are substantial for landowners (Hibbard et al. 2003; Kilgore et al. 2017). The multifaceted structure and inherent characteristics of agroforestry practices – intentional, intensive, interactive, and integrated – may prevent or facilitate these land uses from qualifying for enrollment. For instance, minimum trees per acre requirements for forestry tax programs might prohibit certain agroforestry uses, especially windbreaks and

riparian forest buffers, where the trees are typically grown in narrow strips. Likewise, maximum tree cover requirements or minimum annual income requirements for agriculture tax programs could limit participation by other agroforestry practitioners. Consequently, state mandated PPTP without clear statutory or regulatory guidance may result in various interpretations, and thus, uneven application by county tax administrators.

Cutter et al. (1999) cataloged nine direct and 11 indirect state policies, which promoted at least one of five forms of agroforestry: forest farming, windbreaks, riparian buffers, silvopasture, and alley cropping. Of the 20 policies in the United States, only six states (Delaware, Indiana, Michigan, New Jersey, North Dakota, and Wisconsin) utilized property tax reductions or exemptions to either directly or indirectly encourage the adoption of agroforestry (Cutter et al. 1999). Reviewing existing programs that either support or prohibit agroforestry practices is essential to understanding agroforestry adoption patterns and opportunities.

The overall objective of this study is to identify the current barriers and opportunities in preferential tax policies for agroforestry practices through an extensive review of state PPTP for agriculture and forestry, and where available, agroforestry. We adapted the methodology of Cutter et al. (1999) and Kilgore et al. (2017) to review the tax programs systematically following focus group discussions with regional experts working in agroforestry and related fields. The findings of this study provide a useful summary for policymakers in developing and updating agroforestry-friendly PPTP to ultimately promote agroforestry adoption by landowners. The methods and results of this case study also provide a framework for cataloguing and analyzing tax-program related barriers and facilitators to agroforestry in the rest of the United States.

Methodology

Focus Group Discussion

In November 2020, the research team facilitated a virtual focus group discussion and online forum according to the Institutional Review Board (IRB) guidelines at North Carolina State University (NCSU). The USDA NAC study collaborators provided a list of 18 individuals within their network prior to the focus group discussion and forum. Individuals were regional experts in agroforestry, which is often recognized as a highly specialized topic. Experts were selected from across the nation to ensure representation of various land-use systems. Only a subset of the pool of potential participants were also familiar with PPTPs.

Seven professionals knowledgeable about agroforestry practices and PPTPs ultimately volunteered to participate in the study. As a result, we selected Oregon, Nebraska, Wisconsin, New York, and North Carolina based on the regional experts available and to represent a range of state circumstances including variation in region, property tax policy, and agroforestry practices. Accordingly, there is a possibility for bias since we based our selection of states on the availability of experts that are familiar with both agroforestry systems and PPTPs. For instance, it is reasonable to assume states that include agroforestry practices under PPTPs are more likely than states that do not preferentially assess lands with agroforestry practices to have experts familiar with both subjects. Nevertheless, the research team wanted to ensure the accuracy of the findings through verification by local experts that specialize in PPTP and agroforestry practices before promoting them as case models. The research team then invited the seven experts to garner general information, provide direction in the initial review of property tax assessment of forests and agriculture, and identify potential implications for agroforestry practices.

The research team separated the discussion topics into the following categories: forestry-related characteristics, agriculture-related characteristics, and general management characteristics. Each focus group participant was given the option to contribute or pass to another participant for each of the topics. Focus group participants also had the opportunity to participate in the discussion via a virtual forum. The virtual forum included the topics and prompts featured in the live focus group discussion. The focus group transcript, once verified by participants, was used to provide context to understanding the agroforestry practices common in each state. These insights provided us with an empirical perspective when designing and implementing the review of tax manuals, property assessment statutes, and supplemental publications.

Review Criteria

We adapted the methodology used by Kilgore et al. (2017) to identify statutory, regulatory, and other relevant publications (guides, manuals, etc.). We assessed the sources included in Kilgore et al. (2017), and then performed an online search of each state government agency's websites and supplemental websites to ensure that our database featured current data.

We extracted the following data for each of the selected states:

- a) Name of program and administrative and/or regulatory organization
- b) Ownership requirements
- c) Eligible lands and land-uses
- d) Productivity requirements
- e) Management of lands
- f) Preferential assessment of property
- g) Penalties for non-compliance and disqualification

In addition, we modified the framework utilized by Cutter et al. (1999) to review the publications and categorize PPTP by the compatibility of each policy with agroforestry practices. Cutter et al. (1999) mailed questionnaires to agencies in each of the 50 states in 1995 to collect details on any legislation and/or programs pertaining to agroforestry practices. The questionnaires utilized in the past study included questions on the legislation, program name, agroforestry practices covered, the administrative agencies, program implementation procedures, penalties, participation, and the mission and objectives of the program (Cutter et al. 1999).

Furthermore, we condensed the forestry-related, agriculture-related, and general management characteristics utilized in the focus group discussion to pinpoint “acceptable” and “unacceptable” practices under each preferential assessment in the study (Appendix B). Characteristics used to analyze the eligibility of agroforestry practices included use of trees, grazing livestock in treed environments, production of agricultural and horticultural crops, and an integrated agriculture-forest interface. We also included an “emphasized” category, such as that used by Kilgore et al. (2017), to reflect practices and characteristics of land-uses that were considered particularly noteworthy. We discerned characteristics categorized as “emphasized” from “acceptable” to classify practices related to the main objectives of the programs and those that are directly mentioned and promoted in the publications, whereas “acceptable” practices typically were eligible for preferential assessment within bounds and limits.

Finally, we performed a literature review of both grey and peer-reviewed publications in Google Scholar, Commonwealth Agricultural Bureau (CAB) Abstracts, and the NC State University Summon Database. We utilized combinations of keywords such as “agroforestry,” “barriers,” “opportunity,” and “property tax” to pinpoint publications relevant to the study subject area. Last, we searched the publications and past press releases to identify factors that

affected policy change. This allowed us to note how the programs have evolved over time and which factors encouraged past policy changes. We compiled state profiles with the results from the literature review, state statutes, and supplemental guides. We contacted tax professionals in each of the states to verify our findings and complete any missing information.

Results

We focused our review on the compatibility of agroforestry practice characteristics, instead of specific agroforestry practices following the focus group. The findings from the focus group discussion confirmed our expectations: that agricultural and forest land-uses and the preferential tax assessment of rural working lands vary greatly from state to state. Transitioning the focus from specific agriculture or forestry practices to characteristics allowed us to accommodate for the diversity of programs and land-uses across the sample. There was also overwhelming support from the focus group to identify leverage points for policy change, which we incorporated in our review methodology.

We identified a total of 10 PPTP in the five states in the study area (Figure 4.1). Both North Carolina and Nebraska include all preferential assessments for rural working lands under one program (Appendix C). Oregon has four PPTPs for agriculture and forests, the most among the states chosen for the study. Six programs in the study require a minimum acreage in order to qualify for preferential assessment, two of which are also bounded by a maximum acreage. The most common method for preferential assessments is an income-based use value, which was included in four programs. Wisconsin and New York both assess agricultural land utilizing a different approach than forestlands: use-valuation as opposed to reduced tax rate and reduced fair market value, respectively. Wisconsin is the only state in the sample that lowers the tax liability of rural lands, specifically forestlands, using a reduced tax rate. No assessment program includes

both a reduction in the tax rate and the land valuation for a unified approach to preferential treatment of a single land-use classification. Multiple organizations at the local and state level work collectively to administer and manage each of the programs described in the study. State-specific land assessment characteristics of rural working lands are explained in more detail below.

Nebraska

Nebraska assesses agricultural, horticultural, and forest/timber lands owned by private landowners under the General Property Tax Program (Property Assessment Division 2019; Nebraska Dept. of Revenue 2019). The program is administered cooperatively by the Nebraska Department of Revenue, county tax assessors, the Nebraska Forest Service, and the Nebraska Tax Equalization and Review Commission. The General Property Tax program does not require a minimum or maximum acreage, a minimum income, or a management plan for preferential assessment of any of the three land-use classifications (Nebraska Dept. of Revenue 2019). The program, however, requires that forests maintain at least 35% canopy cover (National Timber Tax 2020a). Lands with less than 35% forest cover are instead classified as grasslands (agriculture). Enrolled lands are taxed at a reduced land-value, currently 75% of the fair market value. There are no penalties, fees, or deferred taxes due upon disqualification or when non-compliant (Nebraska Dept. of Revenue 2019). Kilgore et al. (2017) reported that agricultural producers enrolled in Nebraska's General Property Tax Program save on average \$5.06 per acre per year compared to agricultural lands whose valuation is based on fair market value (FMV).

Unacceptable land-use characteristics under the forest/timber classification include production of agricultural products, grazing of livestock, land left fallow or unproductive, and an integrated agriculture-forest interface (Table 4.1) (Nebraska Dept. of Revenue 2019). The

agriculture and horticulture classifications emphasize land uses that relate to their respective classifications but also include trees when the underbrush is managed and removed. Therefore, the agricultural and horticultural classification permits combinations of trees and crops (silvopasture, alley cropping, and forest farming) (Table 4.2). The forest classification, however, is characterized as having a thick, dense underbrush that is unsuitable for grazing (Nebraska Dept. of Revenue 2019). For that reason, only windbreaks are allowed under the classification for trees and timber.

New York

Privately-owned forests in New York enrolled in the Forestland Program are taxed at a reduced land-value (80% of fair market value) (New York State Dept. of Environmental Conservation 2020). The New York Dept. of Environmental Conservation, county clerks and tax assessors, and the New York Dept. of Taxation and Finance jointly manage the Forestland Program. Meanwhile, the Agricultural Assessment Program reduces the tax liability of enrolled privately-owned agricultural and horticultural lands by basing land-values on productivity potential (use-value) (New York State Dept. of Taxation and Finance 2019). Soil and Water Conservation District Offices and the New York Dept. of Taxation and Finance administer the Agricultural Assessment Program. Forests must be at least 50 acres to participate in the Forestland Program, whereas the agricultural assessment only requires a minimum of seven acres to qualify (New York State Dept. of Environmental Conservation 2020; New York State Dept. of Taxation and Finance 2021). However, agricultural lands less than seven acres may qualify if they gross a minimum of \$50,000 on average in product sales annually.

Forests enrolled in the Forestland Program must adhere to a written management plan for 10 years and contain at least 800 trees per acre (TPA) or, if underplanted, approximately 300

TPA (Bureau of Forest Resource Management 2019). Recently planted and naturally regenerated tracts must be projected to produce a merchantable forest crop in 30 years (New York State Senate 2021). The Agricultural Assessment Program stipulates that farms return at least \$10,000 per year on average (gross) in the two years before receiving preferential treatment, unless the land was leased, experienced damage from a natural disaster, or was under certain conservation programs (New York State Dept. of Taxation and Finance 2019, 2021). Agricultural properties with woodlands of less than 50 acres may also include up to \$2,000 in gross sales of wood products to the \$10,000 income requirement. The Agricultural Assessment Program mandates a conversion fee up to \$1,000 for changing from agriculture to a non-agriculture use (New York State Dept. of Taxation and Finance 2019).

Both the forestland and agriculture assessments require declassified landowners to pay the deferred taxes plus interest for up to 10 years for forests and no more than five years for agriculture (Bureau of Forest Resource Management 2019; New York State Dept. of Taxation and Finance 2019). In the case of deferred taxation statutes when land is converted to ineligible uses, the land is reassessed, and a penalty that is based on the tax savings accrued during the preferential classification period is imposed (Polyakov and Zhang 2008). Lands enrolled in the Forestland Program save an average of \$2.35 per acre per year in property taxes compared to unenrolled forestlands (Kilgore et al. 2017), and savings are even greater compared to agricultural lands enrolled in the Agricultural Assessment Program (\$9.46 per acre per year).

Furthermore, land designated for crop production, for grazing of livestock, as fallow, or as wasteland are not eligible for preferential assessment through the Forestland Program, whereas the Agricultural Assessment Program emphasizes land-uses that combine agriculture and forestry (Table 4.1) (New York State Dept. of Taxation and Finance 2021). As a result, four

of the five agroforestry practices are eligible only under the agricultural assessment: silvopasture, windbreaks, alley cropping, and forest farming. Silvopasture and forest farming, specifically maple production and wild mushroom cultivation, have been added to the program over time (Bond Schoeneck and King PLLC 2015).

North Carolina

Certain lands in North Carolina classified as either agricultural, horticultural, or forestland are appraised at their use values under the Present-Use Value (PUV) program, (North Carolina Dept. of Revenue 2019). The North Carolina Department of Revenue, county tax assessors, the North Carolina Forest Service, the North Carolina Property Tax Commission, and the North Carolina Use-Value Advisory Board jointly administer the PUV program. Individuals and certain trusts and business entities who own at least 5, 10, or 20 acres depending on whether they are horticultural, agricultural, or forestry businesses, may qualify for the use-value assessment. In addition, the PUV program requires that agricultural and horticultural lands must generate at least \$1,000 in gross income on average annually over the three years preceding classification. A forest landowner or consultant must follow a written forest management plan that supports the “commercial production and sale of forest products” to be eligible for the PUV program. Meanwhile, agricultural and horticultural lands must meet one of six characteristics, such as compliance with a farm management plan, to be considered under sound management (North Carolina Dept. of Revenue 2019).

North Carolina’s PUV program mandates a declassification penalty for the three fiscal years preceding disqualification as well as the year of disqualification with interest (2% annual percentage rate) due immediately (Granskog et al. 2002; North Carolina Dept. of Revenue 2019). The PUV program managers may levy a fee equating to 10% of the total deferred taxes plus

interest for failing to report the cause for disqualification (Hamilton et al. 2020). Lands enrolled under the forest classification experience tax savings between \$3.56 and \$7.07 per acre per year compared to lands enrolled under the agricultural classification (Kilgore et al. 2017). Moreover, neither the horticulture nor the forest classifications permit grazing of livestock on lands enrolled in the NC PUV Program (Table 4.1) (North Carolina Dept. of Revenue 2019). The forest class also prohibits land-uses associated with agricultural crop production. Only the agricultural and horticultural classifications allow certain agroforestry practices (Table 4.2).

Oregon

The Forestland Program and Small Tract Forestland (STF) Programs are available to landowners of forests classified as either highest and best use (HBU) or designated forests in Oregon (Oregon Dept. of Revenue 2014a, b, 2017). Both preferential assessment programs for forestlands are managed by the Oregon Dept. of Revenue, county assessment offices, the Oregon Dept. of Forestry, the State Board of Forestry, and the Oregon Dept. of Fish and Wildlife. Farmland within and not within an Exclusive Farm-Use (EFU) Zone may qualify for preferential assessment. Preferential assessment for qualifying farmland is managed by the Oregon Farm Credit Services, the Oregon Dept. of Revenue, and county assessors (Kilgore et al. 2017; Oregon Dept. of Revenue 2014a, b). Private landowners are eligible to participate in the agricultural assessments and the Forestland Program, whereas the STF program specifies eligible participants in more detail: private landowners including individuals, partnerships, certain corporations, estates and trusts, and contract purchasers (Oregon Dept. of Revenue 2017).

The Forestland Program is available to forest landowners with at least two contiguous acres, while only landowners holding between 10 and 5,000 acres of forestland are eligible for the STF Program (Oregon Dept. of Revenue 2017). There is not a minimum or maximum size

requirement if farmland is located in an EFU zone (Oregon Dept. of Revenue 2014a). However, landowners not in an EFU zone are expected to fall within the following acreage categories: less than 6.5 acres, between 6.5 and 30 acres, and greater than 30 acres. Farmland less than 6.5 acres must gross \$650 per year for any three years during the consecutive five-year period before assessment (Oregon Dept. of Revenue 2014b; Oregon Secretary of State 2021). Landowners in the middle size class, between 6.5 and 30 acres, are required to earn \$100 gross income per acre annually for any three years during the five consecutive years before assessment. Finally, the farmland in the largest size class must gross at least \$3,000 per year for three of the five years preceding preferential assessment (Oregon Dept. of Revenue 2014b; OregonLaws.org 2020). The preferential assessment programs do not require a written management plan, but forests enrolled in either the Forestland Program or the STF Program must be adequately stocked, 60-200 TPA depending on stand age and site factors (Oregon Dept. of Revenue 2017).

Each of the assessment programs reduce the tax liability of properties through use-valuation. The Forestland Program taxes land at 100% assessed forestland value, while the STF Program taxes enrolled lands at 20% of their assessed forestland values (Oregon Dept. of Revenue 2017). Deferred taxes accrued during each of the preferential assessments are due from the past five to 10 years depending on the classification, location of the property, and cause for disqualification (Oregon Dept. of Revenue 2014a, b, 2017). Lands enrolled in the Forestland and STF Programs save on average \$2.03 and \$5.20 per acre per year in property taxes, respectively, compared to lands enrolled in either PPTP for agriculture (Kilgore et al. 2017).

The two programs for forestland in Oregon allow grazing of animals but do not permit crop production (Table 4.1) (Oregon Dept. of Revenue 2017). Qualifying lands not located in an EFU zone may include short-rotation hardwoods grown for bioenergy and Christmas tree

production (Oregon Dept. of Revenue 2014b). Lands under either agricultural assessment (both in and not in an EFU zone) may practice four of the five agroforestry practices (silvopasture, windbreaks, alley cropping, and forest farming) due to the inclusion of woodlots less than 20 acres (Table 4.2).

Wisconsin

The Managed Forest Law (MFL) in Wisconsin is a PPTP that levies a flat tax on participating forestlands, the rate of which depends on if the land is open or closed to the public (Kilgore et al. 2017; Wisconsin Dept. of Natural Resources 2021). The MFL program is collectively managed by county tax offices, the Wisconsin Division of Forestry, and the Wisconsin Department of Revenue. On the other hand, agricultural, horticultural, agricultural forest lands may qualify for preferential treatment through the Use-Value Assessment led by the Wisconsin Department of Revenue and the Wisconsin Farmland Advisory Council (Wisconsin Dept. of Revenue 2021). Agricultural forests are assessed on 50% of the land's fair market value and defined as land capable of producing commercial forest products and, generally, are contiguous to parcels classified as agriculture (Wisconsin Dept. of Revenue 2021).

The MFL program is available to all private forestland owners with a minimum of 20 contiguous acres, each capable of growing at least 20 cubic feet of wood per year and consisting of a least 400 planted TPA (800 TPA in natural stands) (Wisconsin Dept. of Natural Resources 2018, 2021). The program allows up to 20% of each forest parcel to be deemed unsuitable to grow timber or to be in an unmanaged vegetation, while the remaining 80% must be in productive forest (Wisconsin Dept. of Natural Resources 2017; National Timber Tax 2020b). Eligible forest landowners in Wisconsin agree to a 25 or 50-year sustainable forest management plan in exchange for preferential assessment (Wisconsin Dept. of Natural Resources 2017).

However, if a landowner fails to follow the mandatory requirements of the MLF program, a non-compliance fee of \$250 is charged by the local municipality.

Inability to follow the approved management plan may lead to withdrawal of MFL designation and an assessment of withdrawal taxes and fees (Wisconsin Dept. of Natural Resources 2017). Generally, fees are the higher of two options: (1) the previous year's assessed land value multiplied by the net tax rate and years of classification, with a maximum of 10 years; or (2) penalizing withdrawn properties by 5% of their stumpage values (Kilgore et al. 2017). Meanwhile, the use-value assessment for agricultural land, including agricultural forests, mandate a conversion fee when enrolled lands are converted to a non-agricultural use plus deferred taxes with interest (Wisconsin Dept. of Revenue 2021). Landowners enrolled in the MFL program experience annual tax savings of \$28.82 per acre on average (Kilgore et al. 2017). However, lands associated with agricultural crop or livestock production do not qualify under the MFL program (Table 4.1). The MFL program does emphasize the use of riparian buffers to mitigate impacts of timber harvest. The agricultural use-assessment, on the other hand, allows silvopastures, windbreaks, alley cropping, and forest farming (Table 4.2).

Discussion

Forest farming, the production of herbs and crops under forest cover, and alley cropping, followed by silvopasture and windbreak configurations, are the most common agroforestry practices allowed under preferential classifications for the five states investigated in this study. Riparian forest buffers are the least common agroforestry practice under preferential classification. Preferential assessment for forests in Nebraska permit windbreaks and riparian forest buffers to be included, while Wisconsin, the only other state that allows agroforestry practices on enrolled forestlands, allows inclusion of riparian buffers. Wisconsin and New York

are the only states in the study where each of the agroforestry practices may receive preferential assessment. We identified at most four agroforestry practices available for preferential treatment under the agricultural classification alone in the study states, with the exception of Nebraska.

Opportunities for Preferential Assessment of Agroforestry

Based on the five states investigated in this study, the greatest potential for preferential treatment of agroforestry exists with agricultural property tax programs. This is due to the frequent inclusion of woodlots and forests less than 20 acres and whose best use is not timber production as eligible land-uses under the agricultural classifications. Each program varies in the specific land-uses allowed, particularly for agricultural crop and livestock production. For instance, New York's agricultural assessment emphasizes an integrated agriculture-forest interface to specifically target landowners interested in silvopasture and forest farming. The Forestland Program and STF Program in Oregon, similar to New York, directly allow grazing of livestock on enrolled forestlands but not production of agricultural crops.

Additionally, programs without acreage size requirements may welcome small-scale agroforestry practices for those landowners considering adoption but who do not want to convert all their land. Nebraska is the only state in the sample that does not require a minimum, or maximum acreage for preferential assessment for agricultural, horticultural, or forest lands. Conversely, Oregon allows farmland of any acreage to potentially participate in use-value treatment but restricts access to preferential assessment to forestlands greater than two contiguous acres. Therefore, Nebraska and Oregon, along with North Carolina, New York, and Wisconsin, present opportunities for agroforestry practices such as windbreaks and alley cropping on smaller landholdings to qualify for preferential assessment.

Likewise, programs without strict, annual income constraints may support adoption of agroforestry practices in the study area that do not produce merchantable material for annual income. Nebraska and Wisconsin do not require a minimum income from agricultural or forest product sales. The assessments for agricultural lands in New York and North Carolina allow landowners to qualify using annual average income over multiple years, while Oregon mandates potential lands not in an EFU zone meet minimum income requirements for three of the five years preceding assessment. None of the preferential assessments for forestlands in the sample institute a minimum income requirement.

Riparian forest buffers may be particularly well-suited for lands under forest classifications, as they do not typically produce commercial products and help mitigate timber harvest practices. Certain riparian lands up to 100 feet from a waterway are exempt from property taxes in Oregon (Oregon Dept. of Revenue 2017; Oregon Dept. of Fish and Wildlife 2021). Meanwhile, riparian zones may qualify under the wildlife conservation classification of North Carolina's Present Use Value Program (North Carolina Dept. of Revenue 2019). In the case of Wisconsin, Cutter et al. (1999) characterized the state's MFL Program as an indirect legislation, which promotes riparian buffers on a maximum of 20% of qualified lands, since these lands may be in swamp, standing water, and/or bog.

Challenges to Preferential Assessment of Agroforestry

Preferential tax assessments for forestlands in the states investigated are less compatible with agroforestry practices than agricultural assessments. Crop production, grazing of livestock, and land classified as fallow or wasteland primarily limit agroforestry from enrolling in preferential assessments for forests, as these were the characteristics with the highest frequency of unacceptable practices. None of the preferential assessments for forestlands in the five states

allow the production of agricultural products on enrolled lands, prohibiting alley cropping and forest farming from preferential treatment in these regions. Furthermore, four of the five states prohibit grazing of livestock on forestland enrolled in preferential assessment programs, restricting access to preferential tax assessment to producers using silvopasture. Consequently, agroforestry practitioners would not be able to access the crucial tax savings that lands enrolled in PPTP for forests experience annually on average.

In addition, size requirements for qualification in preferential assessment may restrict adoption of agroforestry practices, particularly if an integrated agriculture-forest interface is not allowed. As an example, agroforestry practices that qualify for North Carolina's PUV Program would be classified as a single land-use – agriculture, horticulture, or forestry – and would be held accountable for the classification's acreage criteria. Agricultural land enrolled in North Carolina's PUV program, as well as Wisconsin's Use-Value Assessment, may include up to 20 acres of woodlands. Nonetheless, woodlands and forests greater than 20 acres that are capable of timber production must be classified as a forest and meet all associated requirements (North Carolina Dept. of Revenue 2019; Wisconsin Dept. of Revenue 2021). Strict acreage requirements tied to single land-use classifications challenge preferential treatment of agroforestry practices, particularly to the landowners using agroforestry systems that are small in acreage (e.g., windbreaks and riparian forest buffers) but protect and/or treat large acreages of adjacent land.

Similarly, productivity criteria, including timber volume and annual income, may restrict preferential assessment of agroforestry practices in the study area. Forests in New York and Oregon must meet a minimum number of trees per acre or be able to produce a merchantable forest crop within 30 years, as is the case with the New York Forestland Program. On the other

hand, Nebraska classifies forestland as land with trees and a thick underbrush such that livestock are not able to graze. Fully stocked forests typically include a closed canopy, which restricts eligible agroforestry practices to forest farming and riparian buffers. For example, riparian management zones in New York that produce approximately 7 million-board-feet of sawtimber per acre would qualify for preferential assessment if at least 50 acres in size (Jayasuriya et al. 2018). However, agroforestry practices that benefit from a partially open canopy, such as silvopasture in North Carolina with 15-20% forest cover, may not be able to meet the stocking required to receive preferential assessment (Chizmar et al. 2019).

Conclusion

Agroforestry practices in the U.S. – silvopasture, alley cropping, windbreaks, riparian buffers, and forest farming – integrate elements of forests and agriculture. Such agroforestry practices can offer a variety of animal health, farm production, income, and environmental benefits. Having tax and other public policies could help landowners obtain these benefits. We found the integrated land-uses innate in agroforestry preclude them from consideration in certain preferential tax assessments, and thus, crucial tax savings. We identified 10 programs from multiple states across the United States (Nebraska, New York, North Carolina, Oregon, and Wisconsin). Our findings suggest that while agricultural assessments in the study are generally more accepting of small-scale agroforestry practices, lands enrolled in PPTP for forests experience greater tax savings on average annually.

Forest farming and alley cropping, followed by silvopasture, windbreaks, and riparian forest buffers, are the most common agroforestry practices potentially eligible for preferential agricultural classifications in the study area. Minimum acreage, income, and productivity requirements, particularly for programs that prohibit an integrated agriculture-forest interface are

the principal factors limiting agroforests from preferential tax treatment under the existing forestry programs. Stocking requirements for forestlands enrolled in PPTPs largely restrict access to agroforestry practices such as silvopasture, alley cropping, and windbreaks. Preferential tax assessments in Nebraska and Wisconsin are the only programs for forestlands in the study that allow agroforestry. Nevertheless, updates to preferential assessment programs to include agroforestry may capitalize on established frameworks and networks to establish eligibility criteria and disseminate information to landowners.

Sharing the results of these case studies, both the opportunities for and challenges to agroforestry practitioners participating in PPTP, may be educational for landowners, natural resource professionals, and the tax assessment community. Findings from this study may aid landowners in designing agroforestry systems that qualify for their state's PPTP for agriculture and forestry. In addition, conclusions from the state programs investigated may provide case studies for tax assessors and others to model qualifying agroforestry practices. For instance, tax assessors in the states investigated, as well as the remaining states, may utilize the scenarios analyzed in this study to illustrate which agroforestry practices qualify for PPTP in their state.

Further research should expand the scope of this study to assess the compatibility of agroforestry practices with preferential assessment of rural working lands such as agriculture and forests in the remaining 45 states. This study highlights some of the diversity of agroforestry practices and PPTPs across the U.S. However, state-specific analyses of these land-uses and programs in the remaining states is essential to better understand trends and patterns in agroforestry practices and PPTPs for agriculture and forestry. Policy makers can then pinpoint distinct characteristics of various communities and design policies tailored to the unique needs of

landowners across the nation. These types of studies also can be useful to examine if other less conventional conservation practices need policy changes for implementation.

Tables and Figures

Table 4.1: Compatibility of agroforestry-related characteristics with the PPTP in the selected states

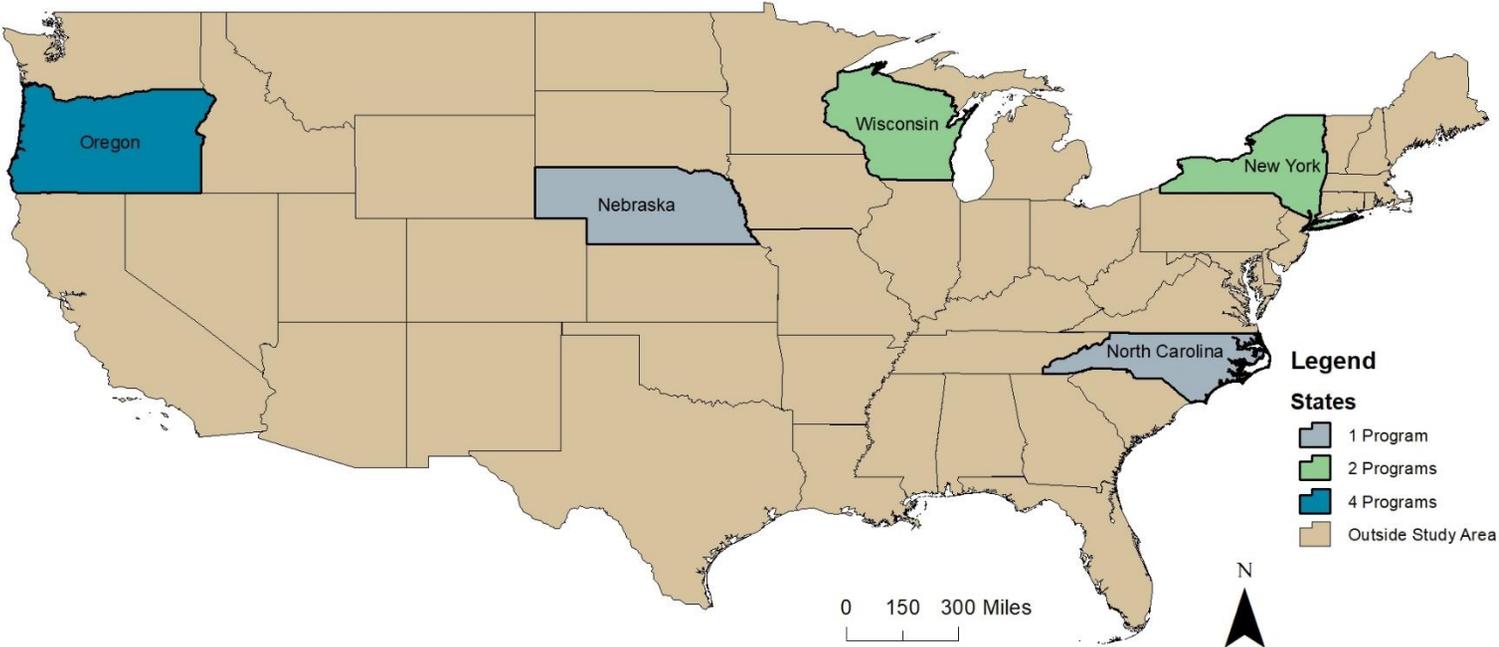
State/Program	NE Gen. PTP			NY		NC PUV			OR					WI	
	For	Ag	Hort	For	Ag	For	Ag	Hort	HF	DF	STF	EFZ	NFZ	For	Ag
<i>Forestry-related</i>															
Commercial (timber) tree species	E	A	A	E	A	E	A	A	E	E	E	A	A	E	A
Nontimber Use of Trees: ecosystem services, aesthetics, etc.	A	A	A	A	A	A	A	A	A	A	A	A	E	A	A
<i>Agriculture-related</i>															
Commercial agricultural/horticultural products (including mushrooms, ginseng, etc.)	U	E	E	U	E	U	E	E	U	U	U	E	E	U	E
Grazing of livestock	U	E	E	U	E	U	E	U	A	A	A	A	A	U	E
Eligibility of Buffers: riparian, vegetative, or tree	A	A	A	A	A	U	A	A	A	A	A	A	A	E	A
Fallow Land and/or wasteland included	U	A	A	U	A	A	A	A	U	U	U	A	A	A	A
<i>General Management</i>															
Include residential area in assessment	U	U	U	U	A	A	A	A	A	A	A	A	A	U	U
Agriculture and forestry interface	U	A	A	U	E	U	A	A	A	A	A	A	A	U	A
KEY: U="Unacceptable;" A="Acceptable;" E="Emphasized"															
Unacceptable: not permitted or rarely permitted on a case-by-case basis															
Acceptable: allowed within limits, permitted but not primary objective															
Emphasized: related to main objective, particularly noteworthy practice															

Acronyms: PTP = Property Tax Program; For = Forest; Ag = Agriculture; Hort = Horticulture; HF = Highest Best Use Forest; DF = Designated Forest; STF = Small Tract Forestland; EFZ = Exclusive Farm-Use Zone; NFZ= Nonexclusive Farm-Use Zone

Table 4.2: Agroforestry practices permitted under each state program in the study area, by land classification

State	Program	Use	Agroforestry types allowed				
			Silvopasture	Shelterbelt	Alley Crop	Riparian Buffer	Forest Farm
Nebraska	General Property Tax Program	Forestland & Timberland		X		X	
		Agriculture	X		X		X
		Horticulture	X		X		X
New York	Forestland Program	Forest					
	Agricultural Assessment Program	Agriculture	X	X	X		X
North Carolina	PUV Program	Forest					
		Agriculture	X	X	X		X
		Horticulture		X	X		X
Oregon	Forestland Program	Highest Best Use (HBU) Forest					
		Designated forest					
	Small Tract Forestland	HBU or designated forest					
	Exclusive Farm-Use Zone	Agriculture	X	X	X		X
Nonexclusive Farm-Use Zone	X		X	X		X	
Wisconsin	MFL Program (replaced Forest Crop Law)	Forest				X	
	Use Value Assessment	Agriculture and Agricultural Forest	X	X	X		X

Figure 4.1: Map of state programs investigated in study, symbolized by number of PPTP per state



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CHAPTER 5: CONCLUSION

Private entities including individuals, partnerships, trusts, estates, associations, organizations, and corporations own 58% of the forest and woodlands in the U.S. (Oswalt et al. 2019). Regardless of ownership, forests produce a suite of non-market goods and services which require market intervention to ensure socially optimal allocations (Frey et al. in review). Instruments such as tax policies and direct financial payments help to correct the market failure preventing socially optimal production of forest-based public goods and services through reducing costs and/or increasing profits from forest management (Chizmar et al. 2021; McGinley and Cabbage 2020; Frey et al. in press).

This dissertation analyzes two distinct types of state-level incentives – cost-share programs and preferential property tax programs (PPTP) – for forest landowners in the U.S. The first paper (Chapter Two) examines cost-share reimbursement programs for forest landowners in the thirteen southern states. State-level cost-share programs in the U.S. South, including the Forest Development Program (FDP) in North Carolina, reimburse costs related to regeneration, planting, and site and timber stand improvement activities to promote sustainable supplies of market and non-market forest-based goods and services. We find that while nine programs still exist in the U.S. South, only seven have an active funding source, many of which are under increased budgetary constraints.

We provide a focused examination of the FDP in the second paper (Chapter Three). Results suggest that chemical release treatments (site preparation), pine hand-planting activities, and larger applied acreage values are positively associated with cost-share project applications that will be completed and will utilize the total allocation. Meanwhile, applications associated with the FDP base fund, non-corporate ownerships, burning practices (site preparation), activities

with a 40% cost-share rate, and applications funded 2017 and prior are negatively related to completed projects and the full utilization of allocations.

The third paper (Chapter Four) assesses state PPTP for agriculture and forestlands in North Carolina, Nebraska, Wisconsin, New York, and Oregon with respect to agroforestry practices. We conclude that preferential tax assessments for agricultural lands in the five states are more likely to favor agroforestry practices than the preferential assessments for forestlands. Findings from the analysis in Chapter Four highlight forest farming and alley cropping as the most common agroforestry practices allowed under preferential tax classifications in the study states.

Budgets for reimbursement payments constrain the ability of cost-share programs to incentivize forest management on private lands. Meanwhile, site characteristics and eligibility requirements generally restrict certain landowners from enrolling in PPTP for agricultural and forest lands. Additional funding for cost-share assistance is necessary to meet current and future demand for forest-based goods and services. Future policy and program modifications and adaptations should continue to capitalize on the complementary elements of state-level incentive programs for forest landowners. For example, the incentive programs identified in this report aim to reduce economic pressures on forest landowners while simultaneously encouraging active forest management on private lands. In addition, the forest management activities recommended by incentive programs commonly foster complementary production of market and non-market forest-based goods and services. Decisionmakers may consider expanding the emphasis of non-market forest products within incentive programs to reach a more extensive and diverse audience of landowners, including agroforestry practitioners.

Limitations and Future Research

The papers in this dissertation are largely limited by their geographic scope. The first paper (Chapter Two) focuses exclusively on the U.S. South, both in the literature review and the assessment of state cost-share programs. The literature review only includes studies that feature federal assistance programs or are national in scope if they specifically emphasize state programs in the U.S. South. While state cost-share programs for forest landowners in the region have traditionally acted as models for the rest of the nation, they may not be applicable in regions which vary from the “Wood Basket.” That is, the U.S. South has an extensive history of intensive forest management for timber production. States that do not share this history or high value for timber may wish to utilize the programs in the U.S. South more as adaptable frameworks than cookie-cutter models.

Similarly, the second paper (Chapter Three) is specific to the North Carolina FDP and may not be generalizable. The program administrators of the FDP maintain rich datasets, much of which was made available to the study investigators. Incentive programs in other jurisdictions, whether local, state, regional, or federal, may not be able to access such detailed historical data, preventing replication of our methodology. Furthermore, the fund allocation problem we analyze in the second paper may not be a concern to administrators of governmental programs that allocate benefits according to a different strategy. Future research should include a survey of cost-share program participants to determine if the FDP induces forest management and how the program impacts wood supply and markets, if at all.

Lastly, the third paper (Chapter Four) evaluates PPTP for agricultural and forest lands in five pilot states. The agroforestry practices and PPTP identified in the five states are quite diverse. PPTP and agroforestry practices in other states may differ greatly from the 10 programs we assess in the third paper. Scaling up to the national level to evaluate programs in the

remaining 45 states is a vital next step for facilitating discussions on relevant and influential policies that may be tailored to local characteristics and needs. In addition, future studies should expand our framework to determine if limited-resource and heir property owners looking to practice agroforestry would qualify for PPTP for agricultural and/or forest lands, as we note many of the programs investigated include strict requirements such as annual income and single land-use acreage.

APPENDICES

Appendix A – Research on state-level forest cost-share programs in the U.S. South (21 studies)

Appendix B – Focus Group Discussion Topics

Appendix C – State preferential property tax profiles

Appendix A

Research on state-level forest cost-share programs in the U.S. South (21 studies)

Study	Geographic Region	Method	Major Findings
Brooks (1985)	U.S. South	Simulation Modeling	Present-value public benefits of cost-share programs exceed discounted program costs while participation in programs remains low. Cost-share programs increase softwood timber supply and lower future wood prices.
Cohen (1983)	U.S. South	Econometric Model	Virginia's state program did not experience capital substitution before 1981 (has pine reforestation law). Approximately half of the acres under the FIP and Mississippi's state program, and over half of the acres under North Carolina's state program would have been planted in absence of the policies.
de Steiguer (1984)	U.S. South	Econometric Model	Reforestation depends on personal income, expected stumpage prices and interest rates, and capital available for tree planting assistance. Real personal income and expected interest rates significantly influence reforestation investment.
English et al. (1997)	Tennessee	Survey-based Logit model	Landowners are concerned with water quality, wildlife habitat, and timber enhancements. Attitudes, experiences, and knowledge of forestry programs may impact the decision to cost-share more than monetary benefits.
Fecso et al. (1987)	U.S. South	Survey	Program evaluation in forestry has traditionally measured performance through "accomplishment" reports which summarize enrollment through the number of landowners, acres, or expenditures. 60% of the surveyed harvested area would be at least moderately impacted by the increased availability of cost-share funds.
Flick & Horton (1981)	Virginia	Benefit-Cost Analysis	The Reforestation Timberlands (RT) Program experienced a benefit-cost ratio of 3.5 in its first 6 years. RT endorsed ~20% of the planted acres in the state between 1972 and 1977.
Greene, Straka, and Cushing (2013)	U.S. South	Review	Forest landowners benefit from federal and state taxes, including property and income, depending on their management objectives. Incentives promote sustainable practices but funding and eligibility limit participation.
Hardie & Parks (1991)	U.S. South	Econometric Model	Cost-sharing possibly encouraged 70% of pine regeneration investment in the South from 1971-1981. Changing cost-share incentive would be effective in impacting planted pine acreage.
Hardie and Parks (1996)	U.S. South	Profit Maximization	Higher cost-share rates are positively correlated with larger tract size. There is a trade-off between changing the cost-share percentage and increasing outreach to landowners, either can change total acreage reforested after clear-cut.
Jacobson et al. (2009)	U.S. South	Survey	State incentives and property tax programs ranked high in awareness and in helping meet timber and conservation objectives. State incentives ranked high in encouraging sustainable forestry
Koesbandana et al. (2017)	North Carolina	Impact Analysis	Incentivized practices as recommended by North Carolina's Forest Development Program returned \$12.5 million in 2012, with \$7.5 million total value added, to the state economy. Regional and state output multipliers ranged from 2.4 to 3.0.

Kreye, Adams, and Ober (2018)	Florida	Survey	Family forest owners (FFO) are skeptical of governmental intervention regardless of available incentives and regulatory assurance. FFO are motivated by their own preferences when costs are low and their autonomy in management decisions.
Li and Zhang (2007)	U.S. South	Spatial Panel Data Analysis	The Southern States are spatially interdependent in reforestation. Harvest, softwood sawtimber price, income, cost of capital, and cost-sharing affect NIPF tree planting. The Soil Bank Program experienced substitution effects in South FL.
Royer (1987)	North Carolina	Regression Analysis	Knowledge of tax incentives may not increase the probability of reforestation where cost-sharing is widely used. Cost-sharing has a positive effect on landowner behavior and any additive effects of tax incentives are limited.
Royer and Moulton (1987)	U.S. South	Survey	The probability of reforestation is increased by almost 20% if a landowner is familiar with either tax incentives or cost-sharing. Landowners familiar with both incentives experience additive effects and are almost 40% more likely to reforest
Stoos, Straka, and Phillips (2017)	South Carolina	Impact Analysis	Additional timberland from the Forest Renewal Program marginally impacts the economy annually by \$4.95 million, generating \$200,000 in delivered value and \$20,000 in tax revenue. The state output multiplier for the program is 5.0.
Sun et al. (2009)	Mississippi	Survey-based selection model	Landowner knowledge of regeneration programs was positively related to land size, regeneration experience, gender, and forest association membership. Application frequencies were higher for landowners with small-ownerships and lower education and income levels as well as fully-employed, female, and non-member landowners.
Tian et al. (2015)	Tennessee	Survey	Landowners interested in the provisioning of ecosystem services are related to socio-demographics, management and ownership characteristics, and availability of financial incentives.
Watson et al. (2013)	Virginia	Survey	Cost-sharing, education, and ownership preferences influence Virginia's Pine Bark Beetle Prevention Program, however, cost-share reimbursements more than 50% are unlikely to substantially increase participation.
Weaver & Bullard (1983)	Mississippi	Review	Mississippi's Forest Resource Development program from 1974 to 1981 was funded by a constant severance tax on timber at primary processing. Increasing harvests or raising tax rates were the only additional funding sources to address higher costs.
Wolde et al. (2016)	Virginia; Texas	Survey	Forestland owners less likely to enroll in incentive programs typically have smaller forestland holdings, less education, and shorter ownership tenure. Previous program participants tend to highly value potential programs.

Appendix B

Focus Group Discussion Topics

- Forestry-related Characteristics
 - Commercial or non-commercial tree species allowed
 - Tree requirement: TPA, density/spacing
 - Use of Trees: commercial timber, ecosystem services, aesthetics, etc.
 - Productivity requirement (annual timber production)
 - Blurred boundaries between forestry and ag. under agroforestry
- Agriculture-related Characteristics
 - Commercial agricultural/horticultural products allowed (including mushrooms, ginseng, etc.)
 - Grazing of livestock allowed
 - Buffers included in acreage: riparian, vegetative, or tree
 - Continuous production requirement (or can fallow land be included)
 - How/if a forestry plan might be required for agroforests
- General Characteristics
 - Annual/Periodic Income requirement
 - Land size requirement
 - Land management plan
 - Include residential area in assessment
 - Landowner classifications eligible
 - Agriculture and forestry interface

Appendix C

State preferential property tax profiles

State		Nebraska		
Program		General Property Tax Program		
Organization		Department of Revenue; County tax assessors; Forest Service; Tax Equalization and Review Commission		
Eligibility	Owner	Agricultural/horticultural landowner		
	Use	Forestland and Timberland	Agriculture	Horticulture
	Minimum Acres	N/A		
	Maximum Acres	N/A		
Productivity Req.	Income	N/A		
	Product	Wood products	Agriculture & horticulture products (including trees & timber)	
Management	Written Plan	No		
	Required Practice	Maintain >35% canopy cover (no stocking standard)	Commercial production of any plant or animal product	
Modified Approach		Reduced FMV		
Land Value		75% actual value (FMV)		
Tax Rate		Standard		
Cap Rate		N/A		
Penalties	Disqualify	N/A		
	Fail to report	N/A		
	Deferred tax	N/A		
	Non-Comply	N/A		

State		New York	
Program		Forestland Program	Agricultural Assessment Program
Organization		Department (Dept.) of Environmental Conservation; County clerk and tax assessors; Dept. of Taxation and Finance	Soil and Water Conservation District Office; Dept. of Taxation and Finance
Eligibility	Owner	Private person or private organization	Agricultural landowners
	Use	Forest	Agriculture
	Minimum Acres	50	7
	Maximum Acres	N/A	N/A
Productivity Req.	Income	N/A	*\$10,000/year
	Product	Production of timber & fiber products; Merchantable forest crop in 30 years	Crops, animals, and plants
Management	Written Plan	Yes	No
	Required Practice	Continuing production of merchantable forest crop; require >800 TPA (trees per acre) or underplant ~300 TPA	Must produce crops, livestock, or livestock products
Modified Approach		Reduced fair market value (FMV)	Current use valuation
Land Value		Up to 80% FMV (formula)	Value-based on soil quality; Set by state annually for 10 soil classes (formula tied to commodity indices)
Tax Rate		N/A	Standard
Cap Rate		N/A	State/special equalization rate
Penalties	Disqualify	Conversion to non-forest use; Owner does not give cutting notice; Owner fails to pay 6% stumpage to county; Failure to comply with management plan for 10-year commitment period	Conversion to non-agricultural use; Rolling 10-year commitment
	Fail to report	Termination of special classification	Failure to notify about conversion results in penalty of 2-payments owed to maximum of \$1000
	Deferred tax	$2.5 \times$ Amount of taxes that would have been levied for current year & for each year prior for which favored classification was granted (limit:10 years); Plus interest charges	$5 \times$ Taxes saved in most recent year + 6% compounded annually for each year land received agricultural assessment (≤ 5 years)
	Non-Comply	N/A	N/A

*Unless leased, subjected to natural disaster, or set aside/retired under Federal management or soil conservation programs; If land <7 acres, may qualify if annual gross sales \geq \$50,000; If woodland eligible, \leq \$2000 included in computation for average gross sales values

State		North Carolina		
Program		Present Use Value Program		
Organization		Department of Revenue; County tax assessors; Forest Service; Property Tax Commission; Use-Value Advisory Board		
Eligibility	Owner	1) Individual 2) Certain Trusts 3) Business Entities		
	Use	Forest	Agriculture	Horticulture
	Minimum Acres	20	10	5
	Maximum Acres	N/A	N/A	N/A
Productivity Req.	Income	N/A	≥\$1000 average gross income per year over the 3 preceding years	
	Product	Commercial growth of trees	Crops, animals, plants	Fruits, vegetables, nursery/floral products
Management	Written Plan	Yes	No	No
	Required Practice	Timber harvest (no stocking requirement)	No	No
Modified Approach		Current use valuation		
Land Value		Value-based		
Tax Rate		Standard		
Cap Rate		9%	6.50%	6.50%
Penalties	Disqualify	N/A		
	Fail to report	Penalty of 10% of total amount of deferred taxes & interest for each listing period for which failure to report continues		
	Deferred tax	Current + 3 past with 2% annual percentage rate		
	Non-Comply	N/A		

State		Oregon						
Program		Forestland Program	Small Tract Forestland (STF)	Exclusive Farm-Use Zone	Nonexclusive Farm-Use Zone			
Organization		Department (Dept.) of Revenue; County assessment offices; Dept. of Forestry; State Board of Forestry; Dept. of Fish and Wildlife			Dept. of Revenue			
Eligibility	Owner	Forest landowners		Individual; Partnership; S and C corporations; Estate or trust; LLC or LLP; Contract purchaser	Agricultural landowners			
	Use	Highest Best Use (HBU) Forest	Designated Forest	HBU or designated forest	Agriculture			
	Minimum Acres	2 Contiguous		10	0			
	Maximum Acres	N/A		5000	N/A	6.5	30	N/A
Productivity Req.	Income	N/A			N/A	≥\$650 gross	\$100 × acres gross	≥\$3000 gross
	Product	Commercial growth of trees			Crops, honeybees, livestock, livestock products, fur-bearing animals, aquatic species, birds	Crops, honeybees, livestock, livestock products, fur-bearing animals, aquatic species, birds, Christmas tree, hybrid hardwoods		
Management	Written Plan	No						
	Req. Practice	Yes - Land must be adequately stocked (60-200 trees/acre dependent on age & site factors)			Land must currently be in "farm use" & activity must be in accordance with "accepted farming practice"			
Modified Approach		Value – based			(Maximum) Specially assessed value			
Land Value		Property taxed on 100% assessed forestland value	Property taxed on 20% assessed forestland value	Income approach				
Tax Rate		Standard						
Cap Rate		N/A			5-year average Farm Credit Services mortgage rate + local property tax rate			
Penalties	Disqualify	Deferred tax						
	Fail to report	N/A						

	Deferred tax	Current + 5 past (real market value tax – Forestland value)	Current + number of years in STF (Forestland value – STF value) + 5 past (real market value - Forestland value)	Up to 10 years (5 years if located within an urban growth boundary) due next tax roll (unless prepay)	Up to 5 years due next tax roll (unless prepay)
	Non-Comply	N/A			

State		Wisconsin	
Program		Managed Forest Law (MFL) Program	Use Value Assessment
Organization		County tax offices; Division of Forestry; Department (Dept.) of Revenue	Dept. of Revenue; Farmland Advisory Council
Eligibility	Owner	Forest landowners	Farmland owner (small and large)
	Use	Forest	Agriculture and Agricultural Forest
	Minimum Acres	20 contiguous	N/A
	Maximum Acres	N/A	
Productivity Req.	Income	N/A	
	Product	Commercial timber products	Agricultural and Livestock products
Management	Written Plan	Yes	No
	Req. Practice	>80% Forest cover, grow 20 cubic feet wood/acre/year; 400 TPA (trees per acre) (plant) or 800 TPA (natural)	Crop and livestock production
Modified Approach		Reduced tax rate	Current use valuation – income
Land Value		Standard – fair market value	Agricultural forest only - assessed at 50% of its full value
Tax Rate		Open - 5%, Closed - 20% average statewide tax on productive forest land	Standard
Cap Rate		N/A	11% or sum of statewide 5-year moving average (whichever is greater)
Penalties	Disqualify	\$300 fee	Conversion charge (to developed use) depends on acreage
	Fail to report	N/A	
	Deferred tax	Up to 10 years	Conversion + 1% interest/month from deferral to date of payment
	Non-Comply	\$250 fee for failure to complete mandatory practices	N/A