Three essays on silvopasture in the southeastern U.S.: Landowner and community assets, natural resource professionals' perceptions, and landowner engagement

by

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Abstract

Today's natural resource professionals (NRP) support landowners in pursuit of multiple objectives, including recreation, income, long-term value creation, and responsibly managing natural resources for future generations. One strategy to meet multiple objectives is silvopasture, an agroforestry practice which dynamically combines timber, forage, and livestock for multiple forest products on a single site. We applied the sustainable livelihoods framework (SLF) to the context of silvopasture managers in the Southeast and the role that NRPs play in enabling or constraining landowners' application of silvopasture in pursuit of their objectives. We identified common management objectives of landowners who practice silvopasture, including wildlife habitat creation, income diversification, and aesthetics, as well as the knowledge and perspectives of the NRPs who support them. Two major human and social capital needs that influence landowners' attainment of their goals are silvopasture-specific technical assistance and specialist support from forestry, forage, and livestock NRPs.

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Table of Contents

List of Tables

List of Illustrations

List of Abbreviations

ACES	Alabama Cooperative Extension System
CRP	Conservation Reserve Program
EQIP	Environmental Quality Enhancement Program
NAC	National Agroforestry Center
NASS	National Agriculture Statistics Service
NRCS	Natural Resource Conservation Service
NRP	Natural Resource Professional
NWOS	National Woodland Owner Survey
RF	Registered Forester
SPSS	Statistical Package for the Social Sciences
USDA	United States Department of Agriculture
USFS	United States Forest Service

Chapter 1: Introduction

Twenty-first century forestland owners and the natural resource professionals who support them are tasked with the challenge of doing more with less – growing additional, higher-quality products on less land using fewer resources, while mitigating negative environmental impacts. At the same time, demand is increasing for forest and agricultural products. One valuable approach for meeting these challenges is drawing upon the positive biological interactions of a suite of plant and animal species, yielding more products than growing one crop alone (Cannell et al. 1996). In this approach, natural resources are managed intensively for multiple benefits: this includes both commercial products such as timber and livestock as well as ecological benefits, such as increased air and water quality, wildlife habitat, and nutrient cycling (Shrestha and Alavalapati 2004). Agroforestry is a land management system that can address many of these needs.

Agroforestry and silvopasture

Agroforestry, as a system of management, combines trees with crops and/or livestock, using technical knowledge from agriculture and forestry as well as the unique interactions that result from the integration of biological components. Within the five agroforestry practices (alley cropping, forest farming, riparian buffers, silvopasture, and windbreaks) exists a range of objectives, from water quality enhancement to economic returns, with multiple benefits noted for each agroforestry practice (Garrett 2009).

Agroforestry bridges the gap between forested ecosystems and agro-ecosystems, providing an important intermediary land use. This type of management utilizes intensive, interaction-based land use systems which involve the growing of trees and agricultural products (i.e. food and fuel crops or livestock) or non-timber forest products (NTFPs), such as mushrooms or pine straw, on the same land unit (Lundgren 1982). Beneficial interactions between trees, crops, and animals can minimize waste and maximize land use, allowing landowners to optimize the use of their land and receive more regular income from diversified products than would be possible in a monoculture system.

One of the more common forms of agroforestry is silvopasture, a complex, dynamic management system of timber, forage, and livestock for multiple forest products on a single site. Based on beneficial interactions among a suite of species and the production of multiple products, the ecological and economic diversity resulting from this integration requires intensive management to maximize the productive potential of this type of system. As an intensive agroforestry system, more cattle and timber can be grown on less land while mitigating environmental challenges such as erosion. This system, or various forms of it, such as woodland grazing, has a long history in the southeastern United States.

Silvopasture suitability for the southeastern U.S.

As a region, the Southeast is well suited for silvopasture success due to its long growing season, existing timber markets, increasing urban demand for high quality timber and meat products (e.g. grass fed, humanely raised, locally produced), and the large amount of forestland owned by private landowners. Across the eastern U.S., 81 % of forestland is privately held, with 147 million acres of forested land in private, non-corporate hands in the southeastern U.S.:

considerably more than the North (100 million acres) and West (41 million acres) (USFS 2008). In a national survey, private landowners reported that the top reasons they own forestland were for aesthetic value, to pass on to heirs, as part of a family farm, for recreation, and for timber production (Butler 2008). These reasons are all compatible with silvopasture and support research findings that pine silvopasture is well-suited for the Southeastern region (Ares et al. 2003; Brauer et al. 2009).

In fact, silvopasture is experiencing a renaissance; since European conquistadors explored North America, cattle have grazed the forests of the South, and before that, bison, elk, and other large fauna shaped the ecosystem as agents of disturbance (Denevan 1992). In the lower coastal plain region, which includes southern Alabama, Mississippi, and Georgia as well as much of Florida, European settlers managed timber and forest rangeland for forest products, forage, and livestock (Wahlenberg 1946). Open grazing of vast tracts of forestland was common practice until after the Civil War, when farmers called for strengthening property rights laws in the form of closing the range. Cropland owners succeeded in instituting laws at the state and local level to hold livestock owners responsible for damages to farmers' crops, transitioning from "fence-out" laws, or open range, to "fence-in" laws, or closed range (Kantor 1998). Beyond the period of time when open range was the norm, forestland owners maintained cattle herds and leased forestland for grazing. Several Forest Service publications detail the management of both pine and hardwood forests for cattle grazing and the opportunities forested range provide (Johnson 1960; Grelen and Duvall 1966; Pearson et al. 1982). Extensive (as opposed to intensive) grazing of native forages is still practiced in some areas of the lower coastal plain. However, for various reasons, contemporary natural resource professionals (NRPs) often hesitate to recommend it as a land management practice (Zinkhan 1996).

In their economic analysis of actual field trials of a South Mississippi silvopasture, Grado et al. (2001) found that land expectation values (LEVs) for silvopasture were higher than multiple grazing or forestry applications alone, except for the steer grazing treatment. They couched their results with some contextual factors: the study location has high physiographic potential for cattle and timber production, and economic returns depended strongly on cow and steer prices, which are variable, though currently at a historic high (USDA 2015). The wildlife component and associated income from fee hunting was the primary factor for the superior financial performance of silvopasture over open pasture cow grazing. One important consideration is the design of the study and the precise management: with increased intensification, increased specificity of management interventions is required to achieve the greater returns. This is especially true with regard to timing of management (e.g. pruning, thinning, introduction of cattle to young pines) (Nyland 2007; Hamilton 2008; Cubbage et al. 2012). Despite these field trial results, NRPs remain skeptical of the profitability of silvopasture (Workman et al. 2003). Additionally, it is worth noting that the reasons for owning forested land landowners rank highest are not financial, but are: beauty/scenery, to pass on to heirs, privacy, and nature protection, and part of home or cabin (Butler 2008). Only 5% of the family forest owners, owning 10 % of the land in family forests, reported that their primary occupation is a farmer. Thus, 95 % or more of the family forest owners rely on off-farm income (Butler 2008). For landowners whose most important reasons for owning land are non-financial, land uses that achieve their highly-ranked objectives (e.g. beauty/scenery, to pass on to heirs, nature protection) that include financial returns may be particularly attractive.

In an effort to understand better why this is and how NRPs perceive agroforestry practices, over the last few decades agroforestry researchers have published results of surveys of

two populations involved in facilitating adoption of agroforestry practices (including silvopasture) to identify enabling and constraining variables to the practice of agroforestry, as well as to gauge landowner and NRP interest and practices related to agroforestry (Zinkhan and Mercer 1996; Zinkhan 1996; Workman et al. 2003).

Agroforestry adoption in temperate North America

Natural resources professionals, often in partnership with rural sociologists, have a long history of studying the spread of agricultural practices or innovations. This tradition, grounded in the work of Everett Rogers, is called adoption-diffusion (Rogers 2003). With regard to agricultural practices, Rogers and others following his tradition (Rogers and Ban 1963; Rollins 1993; Schwarz and Ernst 2009), identified two primary groups: the end users (e.g. farmers, forestland owners, cattlemen), and the professionals who engage with the end users (e.g. crop and soil scientists). Thus, agroforestry research has included investigation into these two important groups.

Several studies were designed to analyze both the NRPs influencing adoption as well as adopters or potential adopters (e.g. landowners, farmers, livestock producers, etc.) (Lawrence and Hardesty 1992; Lawrence et al. 1992; Workman et al. 2003), while others targeted landowner or farmers only (Matthews et al. 1993; Strong and Jacobson 2006; Dyer 2012; Dyer et al. 2015) or NRPs only (Zinkhan 1996; Zinkhan and Mercer 1996) (Table 1). Of the surveys that targeted NRPs, no two groups of researchers had an identical sampling frame (Table 1), which differed by region of analysis as well as by NRP groups (or others) included. These differences limit comparisons across studies though analyzing this variation does elicit common themes.

Table 1: Titles, authors, dates, locations, populations, methods, and response rates of North American temperate agroforestry adoptions studies

	Title	Location	Survey population	Survey Method	Response rate
Lawrence et al. 1992	Agroforestry practices of non-industrial private forest landowners in Washington State	Pacific Northwest US (WA--3 regions of 4 contiguous counties each)	Forest landowners	Dillman TDM	64 %
Lawrence & Hardesty 1992	Mapping the territory: agroforestry awareness among Washington State land managers	Pacific Northwestern US (WA)	Natural resource professionals (NRPS) (USDA Soil Conservation Service [now NRCS], Cooperative Extension, and others, including university faculty and students, Department of Natural Resources foresters, leaders in the alternative agriculture community, and landowners with a known interest	Dillman TDM	45 %
Matthews et al. 1993	Landowner perceptions and the adoption of agroforestry practices in southern Ontario, Canada	Southern Ontario, Canada	Farm households in 4 townships in Wellington County, Southern Ontario, Canada	Unspecified	unreported
Zinkhan & Mercer 1996; Zinkhan 1996	An assessment of agroforestry systems in the southern USA Public Land-Use Professionals' Perceptions of Agroforestry Applications in the South	Southeastern US (AL, AR, FL, GA, LA, MS, NC, OK, SC, TN, TX, VA)	NRPs (Cooperative Extension, State Forestry Divisions, USDA Soil Conservation Service [now the NRCS])	Unspecified	unreported
Workman, Bannister, & Nair 2003	Agroforestry potential in the southeastern United States: perceptions of landowners and extension professionals	Southeastern US (Atlantic and Gulf Coastal Plain, including portions of AL, GA, and FL)	Forest landowners, farmers, and NRPs (Cooperative Extension, State Forestry Divisions, NRCS)	Dillman TDM	42 %
Strong & Jacobson 2006	A case for consumer-driven extension programming: agroforestry adoption potential in Pennsylvania	Mid-Atlantic US (PA)	Members of PA Association of Sustainable Agriculture and Woodland Owners Association	Dillman TDM	44.6 %
Dyer 2012, Dyer et al. 2015	Three Essays on Pine Straw in Alabama: Needlefall Yields, Market Demands, and Landowner Interest in Harvesting Factors affecting Alabama landowner interest in harvesting pine straw and willingness to accept prices	Southeastern US (6 counties in AL)	Forest landowners in Alabama	Dillman TDM	38 %
Stutzman 2016 (present study)	Three essays on silvopasture in the southeastern U.S.: landowner and community assets, natural resource professionals' perceptions, and landowner engagement	Southesastern US (AL, GA, FL, MS)	NRPs (Cooperative Extension, State Forestry Divisions, NRCS, Registered Foresters)	Dillman TDM	44.9 %

Of the studies that focused on the southeastern U.S., Zinkhan and Mercer (1996) found that economic factors predominated in the benefits NRPs noted for agroforestry, but Workman et al. (2003) found that the most important benefits NRPs noted were wildlife habitat, water quality, soil conservation, water quantity, long-term investment, and aesthetics. This difference likely stems from methodological approaches: in their questionnaire, Workman et al. (2003) asked NRPs to rank the importance of a list of variables the authors provided while Zinkhan and Mercer (1996) asked NRPs "…to supply up to three likely reasons for the creation of observed agroforestry systems…"(Zinkhan 1996). Nevertheless, this discrepancy, with its numerous implications for agroforestry, brings up the question: How do NRPs and landowners prioritize economic benefits and environmental benefits? Dyer (2012) provides some insight to landowners' management decision making framework, and the answer is not simple.

Dyer (2012) surveyed Alabama landowners about their interest in practicing agroforestry on their land. While the bulk of her analysis focused on the production of pine straw, an agroforestry practice in the forest farming category, she reported on landowners' interest in agroforestry as well as the statistically significant reasons to practice or not to practice agroforestry. She found that "leaving a legacy for heirs" was a high priority, with 54 % of respondents indicating that this is "very important" and an additional 28 % find this "somewhat important." Two categories of findings indicate that landowners see this legacy as encapsulating both environmental benefits (soil conservation, improving wildlife habitat, improved water quality) and financial benefits (increased land value). When landowners consider agroforestry, it is in the context of weighing the potential legacy benefits (environmental and financial) against the highest-ranked reasons not to practice agroforestry, both cost related (high investment costs

and high maintenance costs, ranked by 38 % or respondents as “very important”) (Dyer et al. 2015).

The diverse characteristics and goals of potential agroforestry adopters and the NRPs they access are likely to influence the answer to that question. One study that differentiates between types, or "clusters," of landowners is Strong and Jacobson (2006): their methodological approach differs in one important way from that of other researchers in that they assess agroforestry adoption while differentiating between two populations of landowners in Pennsylvania: Woodland Owner Association (WOA) members and Pennsylvania Association for Sustainable Agriculture (PASA). They use market segmentation and perform two-step cluster analysis to produce four models of agroforestry adoption potential. They found that their first cluster, which they term timber-related practices, is comprised of WOA members who are most invested in crop tree management, the importance of current timber production, hunting, and other forest-related recreational pursuits to current land management (Strong and Jacobson 2006). They ranked the benefits of wildlife, soil protection and biodiversity highly, and their main barriers to adoption included perceptions of competition from deer browsing, trespassing, time, and equipment availability (Strong and Jacobson 2006). In summary, for forestland owners, agroforestry is acceptable insomuch as it is consistent with current timber production and enhances currently held environmental and economic objectives such as wildlife and long-term economic returns. However, WOA members are not likely to increase investment labor and capital in order to intensify land management, as some agroforestry practices require.

Silvopasture is certainly intensification as compared to traditional timber management without livestock. According to Strong and Jacobson (2006) another “cluster”, the livestock-related practices cluster, is made up of PASA members who are interested in agroforestry

practices that complement their current livestock activities. A large proportion selected silvopasture as the agroforestry practice they were most likely to adopt, along with wind breaks and riparian buffers. This cluster is comprised of landowners with fewer than 100 acres who receive their primary income through full-time farming and livestock production. They were much more likely than the timber-practice-related cluster to be interested in financial and production benefits (Strong and Jacobson 2006).

The timber-related practices cluster is likely to be motivated by non-economic benefits (e.g. wildlife), which was expected, since they often derive their primary income from off-farm work . This finding contradicts the economic benefits NRPs highlight in Zinkhan and Mercer's (1996) study and supports the findings of Workman et al. (2003) of the top benefits NRPs and landowners expect from agroforestry. Interestingly, the livestock-related practices cluster of Strong and Jacobson (2006) ranked production benefits such as “protects soil” and “provides shade for livestock” as more important benefits to agroforestry than environmental benefits such as “enhances wildlife habitat.” This group also perceived access to technical and marketing information, as well as inability to invest labor and capital into new infrastructure or seedlings/seeds to be major obstacles (Strong and Jacobson 2006). A strong opportunity appears to exist for NRPs to connect with members of the sustainable agriculture community (e.g. PASA), many of whom have owned land for less than 20 years, to address perceived barriers to agroforestry adoption.

These studies emphasize that the local and regional context (e.g. landowner characteristics, site characteristics, agriculture and natural resource policy), applied in practice with the support of engaged professionals, provides the basis of agroforestry adoption. Furthermore, not all agroforestry practices are equal: among the array of agroforestry practices,

some are more specifically relevant to a particular context, and others not at all (Zinkhan 1996; Workman et al. 2003; Strong and Jacobson 2006; Dyer 2012). Underlying the context is the authority of the private landowner, whose agency over their land is preeminent. To date, no silvopasture-specific adoption studies have been undertaken in the temperate U.S. A few previous studies, however, have asked questions specific to silvopasture amid questions related to other agroforestry practices (Zinkhan 1996; Zinkhan and Mercer 1996; Workman et al. 2003; Dyer et al. 2015). For example, Zinkhan (1996) asked NRPs about their evaluations of alternative categories of agroforestry systems, including timber-forage-livestock, which describes silvopasture. Thus, the current study of the perceptions and practice of Natural Resource Professionals (NRPs) with regard to silvopasture in the Southeastern U.S. builds upon and updates the work published previously by agroforestry scholars.

Adoption: Natural resources professionals and private landowners

Natural resource professionals, whether employed by federal and state agencies (e.g. Natural Resource Conservation Service [NRCS], Cooperative Extension, United States Forest Service [USFS], state forestry commissions) or privately contracted (e.g. registered foresters who consult with private forest landowners) are in a professional position of advising landowners on appropriate land uses as well as providing the necessary technical support to establish and manage agroforestry systems effectively. Despite decades of scientific research and economic analyses, many landowners and the NRPs who serve them report low levels of knowledge about silvopasture (Workman et al. 2003; Dyer 2012). One reason for low adoption is the steep learning curve landowners must overcome when adopting silvopasture. Compounding this challenge, technical support from NRPs well-acquainted with silvopasture and local contexts is often not readily available (Workman et al. 2003). If the conservation value and economic

potential for silvopasture is to be realized, the information that exists must be appropriately channeled to landowners (Grado et al. 2001; Stainback and Alavalapati 2004; Shrestha and Alavalapati 2004; Shrestha and Alavalapati 2004; Karki and Goodman 2012).

Temperate agroforestry is a timely topic; there has never before been such great interest in understanding current practice and science by U.S. institutions. This is evidenced by The National Agroforestry Center's Strategic Framework, Fiscal Year 2011-2016, which outlines the USDA's concerted and coordinated efforts to promote agroforestry practices throughout its multi-scaled agency for conservation and economic development (USDA 2011). Additionally, the Society of American Foresters has highlighted agroforestry research presentations in dedicated tracks during their 2013 and 2014 national conventions (Society of American Foresters 2012; Society of American Foresters 2013). The USDA's 2012 Census of Agriculture included for the first time a question about silvopasture, asking all farm households, "At any time during the previous year, did you practice silvopasture or alley cropping?" Results indicated that 119 farms in Alabama answered "yes" to that question. Alabama tied for sixth place with North Carolina in the total number of farms per state practicing silvopasture or alley cropping, behind Texas (199), New York (186), Pennsylvania and Missouri (both with 141), and Florida (137). Of all the farms in the U.S., 2,725 report practicing silvopasture or alley cropping in the 2012 Census of Agriculture (USDA 2014).

Study objectives

The purpose of this study is to shed light on the provision of education and technical assistance available to current and prospective silvopasture managers. I focus on the relationships between NRPs and silvopasture managers in order to study the influences of NRPs

on landowner learning, mediate access to technical assistance, and foster landowners' successful adoption of silvopasture as a land management system. To that end, my project's objectives are presented as results in this dissertation in the form of three separate studies:

1. The objective of the case study of landowners and NRPs engaged in silvopasture is to elucidate the breadth and depth of landowner and NRPs' attitudes, practices, information needs, appropriate sources of information, and technical assistance needs. This objective was achieved through analyzing data collected during semi-structured interviews with NRPs and landowners in order to answer the following research questions:

    a. What capitals and structures influenced landowners to adopt the practice of silvopasture?
    b. What capitals, structures, and desired outcomes do NRPs consider when choosing whether or not to recommend silvopasture to a particular landowner?
    c. What structures and processes from NRPs and NRP organizations (cooperative extension, Natural Resource Conservation Service [NRCS]) influence landowners' silvopasture-related livelihoods outcomes?

2. The objective of the quantitative analysis of a web-based survey of NRPs based on findings from objective 1 above was to:

    a. Learn more about their familiarity, learning, and perceptions of suitability of silvopasture as it pertains to their professional roles. In other words, how do NRPs regard silvopasture relative to their professional scope of work and the context—physiographic (e.g. soils, climate) and cultural (e.g. the accepted

practices of local cattlemen and landowners)—in which they work. This study sought to:

b. Distinguish between four professional classifications of NRPs (i.e. state forest services, NRCS district conservationists, cooperative extension, and registered foresters)
c. Distinguish between four Southeastern states (i.e. Alabama, Florida, Georgia, Mississippi)

3. To investigate the information exchange between landowners and NRPs about silvopasture, to gauge NRPs' perceptions about the suitability of silvopasture for the landowners they work with, and determine how their professional experience and networks influence their engagement with landowners around silvopasture, the web-based survey outlined in number 2, above, was also used to:

a. Distinguish between the attitudes and practices of four professional classifications of NRPs (i.e. state forest services, NRCS district conservationists, cooperative extension, and registered foresters)
b. Distinguish between the attitudes and practices of NRPs in four Southeastern states (i.e. Alabama, Florida, Georgia, Mississippi)

In order to achieve these objectives and answer my research questions, I employed two methods of social science research: qualitative case study analysis and quantitative analysis of survey data. Results from these two methods of inquiry form a multiple methods approach to updating previous temperate agroforestry adoption literature by elucidating the current state of

silvopasture knowledge and applicability of two important user groups: landowners who may consider silvopasture as a land use strategy and the professionals who advise them.

This study is unique in that it is the first agroforestry survey to use Dillman's Tailored Design Method for an internet survey (Dillman et al. 2009), as well as the first survey to focus on silvopasture instead of agroforestry more generally. Furthermore, my qualitative inquiry into the attitudes and practices of silvopasture managers and the NRPs who advise them represents the first of its kind. To this point, all published social research on agroforestry in the temperate U.S. has been quantitative.

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Chapter 2

Title: Alabama landowners and natural resource professionals spiral up landowner and community assets through silvopasture

Abstract

Sustainable community development relies on a secure base of natural capital. At the forefront of managing environmental assets are natural resource professionals (NRPs) and landowners who pursue multiple objectives, including recreation, income, long-term value creation, and responsibly manage land for future generations. One strategy to meet multiple objectives is silvopasture which dynamically combines timber, forage, and livestock. We applied the sustainable livelihoods approach (SLA) and the community capitals framework (CCF) to analyze a case study on silvopasture managers and NRPs in Alabama. We identified common livelihoods outcomes of landowners who practiced silvopasture, including wildlife habitat creation, income diversification, and aesthetics, along with perspectives of NRPs who support them. Two major human and social capital needs that influenced landowners' attainment of their goals were silvopasture-specific technical assistance and specialist support from forestry, forage, and livestock NRPs. Application of results inform future design of land-use-related projects and assessment of impact.

Introduction and literature review

If community development in previous eras considered the environment primarily for its extractive or productive value (Green and Haines 2011), communities (including landowners, natural resource professionals (NRPs), and community-based organizations (CBOs) are now

tasked with evaluating multiple uses (and non-uses) of natural resources and selecting among them for desired long-term natural, social, and economic outcomes (Green and Haines 2011). It follows that twenty-first century forestland owners and the NRPs and CBOs who support them are tasked with the challenge of supporting landowners in pursuit of multiple objectives, including recreation, income, long-term value creation, and responsibly managing natural resources as a legacy for future generations. One approach for meeting these landowners' objectives draws upon the positive biological interactions of a suite of plant and animal species to yield more products than growing one crop alone (Cannell et al. 1996). Agroforestry combines trees with crops and/or livestock, using technical knowledge from agriculture and forestry as well as the unique interactions that result from the integration of the biological components of the particular system. Within the five agroforestry practices (alley cropping, forest farming, riparian buffers, silvopasture, and windbreaks) exists a range of objectives, from water quality enhancement to economic returns, with multiple benefits noted for each agroforestry practice (Garrett 2009).

Silvopasture is a complex, dynamic, and intensive management system of timber, forage, and livestock for multiple forest products on a single site. The nuanced management of multiple species (timber, forage, and livestock) for beneficial interactions distinguishes a silvopasture. Longleaf pine (*Pinus palustris*), shortleaf pine (*Pinus echinata*), slash pine (*Pinus elliottii*) and loblolly pine (*Pinus taeda*) are commonly planted in or thinned to two or three rows of timber with widely spaced alleyways in between, and the timber component is managed for high-value timber product classes (Hamilton 2008). The extensive scale of the forest industry in the southeastern US and economic value of forestry, 2 % of Gross Regional Product (GRP) and 4.5 % in Alabama influence perceptions that this region is well-suited for silvopasture (Gold and

Hanover 1987; Merwin 1997; Brandeis and Hodges 2015) Other enabling factors include a long growing season, existing timber markets and increasing urban demand for high quality timber and meat products (e.g. grass fed, humanely raised, locally produced) (Cox et al. 2006; Belcher et al. 2007; Umberger et al. 2009), and the amount of forestland owned by private landowners. Across the eastern United States, 81 % of forestland is privately held, with 147 million acres of forested land in private, non-corporate hands in the southeastern U.S., considerably more than the North (100 million acres) and West (41 million acres) (2014a). The goals and uses by landowners who control these environmental assets have implications for community development of the region.

A dramatic shift has occurred in recent decades: U.S. landowners' goals have morphed from primarily financially-driven use values to lifestyle-related, un-priced use (e.g. recreation) and nonuse values (e.g. as a legacy for future generations, personal enjoyment of natural areas). In a national survey, private landowners reported that the top reasons they owned forestland were for (1) aesthetic value, (2) to pass on to heirs, (3) as part of a family farm, (4) for recreation, and (5) for timber production (Butler 2008). These landowners managed for multiple objectives, of which income may be one ancillary goal, and timber management may have been one of several profitable activities. These goals are all compatible with silvopasture and support research findings that have shown pine silvopasture was well-suited for the Southeastern region (Ares et al. 2003; Brauer et al. 2009).

Aggregated to the community level, we see communities' increasing value of non-use environmental capital values--for example in the amenity value of the preservation of forested land. In decades past, environmental assets were largely ignored in the community development literature. Insomuch as they were considered, financially productive use values (e.g. timber

production, mining, agriculture) were prioritized above non-use or amenity values (i.e. natural and human-created, place-based features that could be preserved or destroyed, and if preserved or promoted, could accrue use and non-use benefits; amenities may be leveraged in creation of other capitals.) (Green and Haines 2011). To remain consistent with landowners' goals and communities' holistic development, NRPs and community-based organizations (CBOs) should respond to these changes in landowners' objectives for owning forestland. One such response was taking place around agroforestry (Workman et al. 2003).

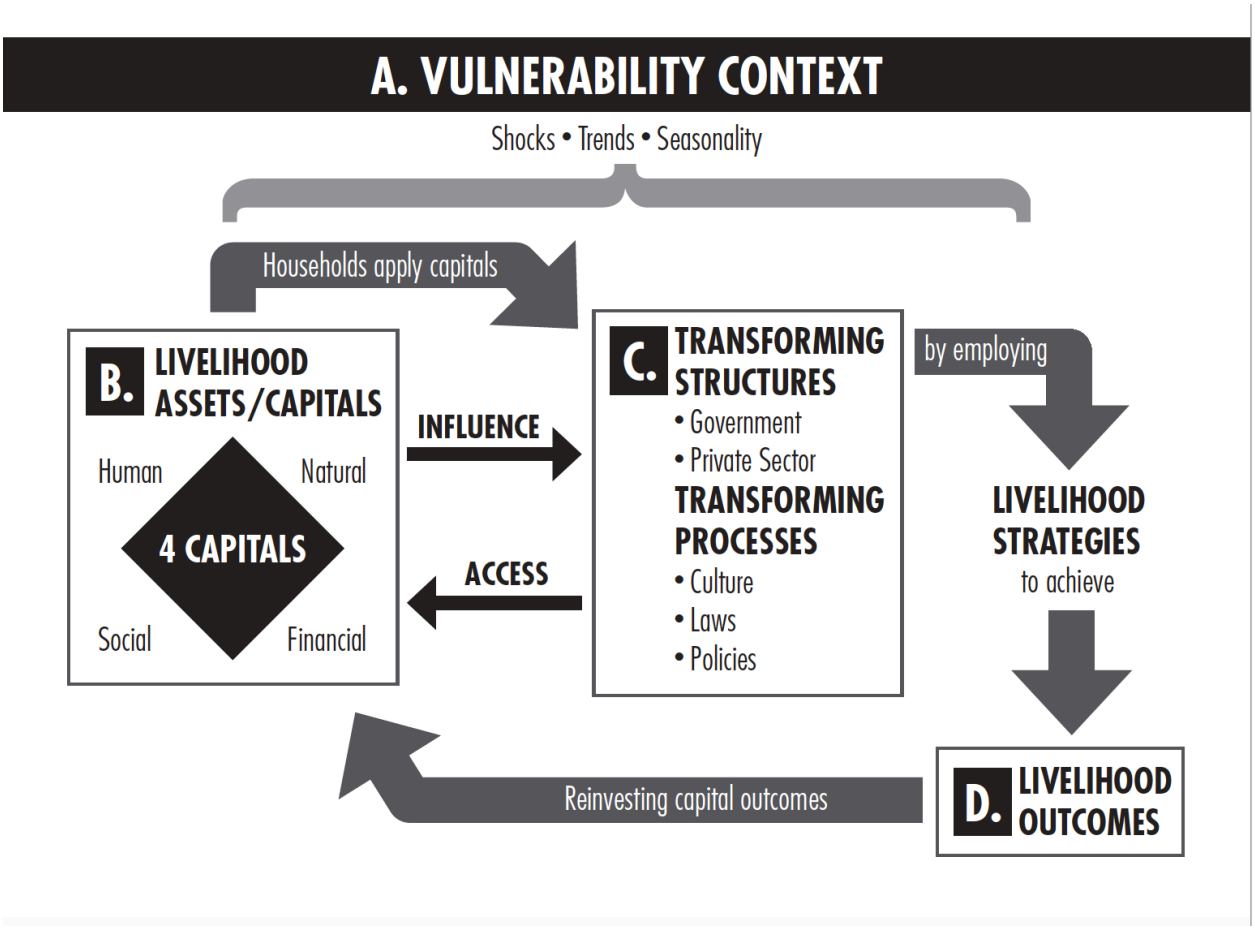
On a national level, there have been strong indications of interest in understanding current practice and science and measuring agroforestry applications. The National Agroforestry Center's Strategic Framework, Fiscal Year 2011-2016 outlines the USDA's concerted efforts to promote agroforestry practices throughout its multi-scaled agency for conservation and economic development (USDA 2011). Additionally, the Society of American Foresters highlighted agroforestry during their 2013 and 2014 national conventions. The USDA's 2012 Census of Agriculture (USDA 2014) included the first-ever question about agroforestry, asking all U.S. farm households, "At any time during the previous year, did you practice silvopasture or alley cropping?" The census yielded 119 farms in Alabama answering affirmatively. Alabama tied with North Carolina for sixth place in the total number of farms practicing silvopasture or alley cropping, behind Texas (with 199), New York (186), Pennsylvania and Missouri (both with 141), and Florida (137). Of all U.S. farms, 2,725 report practicing silvopasture or alley cropping (USDA 2014).

Given the diverse goals for employing silvopasture, we selected people-centered frameworks that account for multiple forms of worth, or capitals. They emphasize social capital, as we were particularly interested in landowners' relationships with natural resources

professionals (NRPs) who interacted with them around land-based decisions and provided access to other capitals (e.g. human and financial). The sustainable livelihoods approach (SLA) and community capitals framework (CCF) fit these goals. They are complimentary, people-centered, system-level approaches for understanding how households and communities draw from their stores and resources to fashion a living for themselves through a repertoire of activities (Gutierrez-Montes et al. 2009). Both approaches aided us in understanding the interaction among local economies, natural resources, and community development, and opportunities and constraints to achieving positive outcomes across capitals (Gutierrez-Montes et al. 2009).

The sustainable livelihoods approach (SLA) (figure 1) is a tool for understanding and analyzing strategies and resources individuals and households employ to achieve desired outcomes (Chambers and Conway 1991; Chambers 1994; Scoones 1998; DFID 1999). Within the vulnerability context and the context of transforming structures and processes, livelihood assets are mobilized in order to achieve livelihoods outcomes, which then expand the household asset base. Livelihood outcomes (figure 1, d) are households' desired achievements, such as increased wellbeing, more sustainable use of the natural resource base, etc.

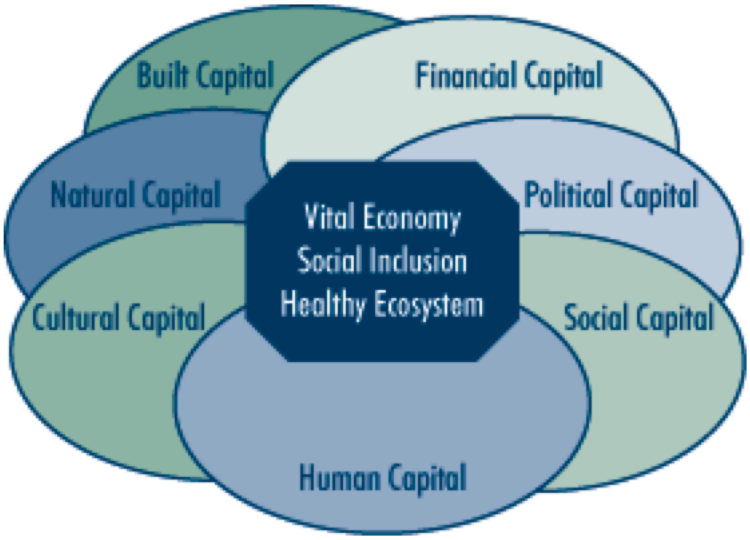
Figure 1. Graphic depiction of the sustainable livelihoods approach as outlined in the Sustainable Livelihoods Guidance Sheets (DFID 1999), with Scoones' (1998) four capitals (human, natural, financial, and social)



Scoones (1998) outlines three categories of livelihood strategies that are commonly employed by rural individuals and households: agricultural intensification/extensification diversification, and migration. Silvopasture falls into Scoones' (1998) categories of agriculture intensification and diversification because it is commonly one of a suite of land-use practices and complemented by other household livelihood strategies (both on and off-farm) and is based on increased levels of inputs (in the case of silvopasture, labor) to produce a greater volume of high quality (and thus valuable) products.

The impetus behind the creation of the CCF was community scholars' assertion that capitals possessed by individuals and households, as in the SLA, may be aggregated to the scale of the community. The CCF offers a system-level framework for analyzing stocks of community assets, identifying activities that alter resources, analyzing community development efforts and prioritizing decisions that accrue multiple forms of capital for sustainability over the long term (Gutierrez-Montes et al. 2009; Flora et al. 2015). The CCF identifies the following capitals: built, financial, political, social, human, cultural and natural (Emery and Flora 2006; Flora et al. 2015). Figure 2 shows that these capital categories intersect, with the three characteristics of sustainable communities in the center: healthy ecosystems, economic security, and social inclusion. The SLA and the CCF are complementary frameworks, with the CCF offering cultural and political capitals to fill in gaps left by the SLA's rather nebulous "transforming structures and processes" category, where it becomes muddled with institutions, organizations, and policies (Gutierrez-Montes et al. 2009).

Figure 2 The community capitals framework (Emery and Flora 2006; Flora et al. 2015)



Flora et al.'s (2015) CCF defines several categories of community assets, all of which may be influenced by human activities. Underpinning all other capitals, natural capital includes the air, water, soil, geology, wildlife, flora and fauna, and climate of a place. Cultural capital is a community's world view, including norms, symbols, language, history, what is valued or taken for granted. Human capital is the abilities and potential of individuals, often measured in terms of education, skills, health, and self-worth. Political capital is the power of a community or group to codify its norms and values into policies that determine distribution of forms of power, as well as the ability to enforce rules. Built capital is synonymous with infrastructure; it is the human-created environment which may, but does not always, contribute to other community capitals. Legacy is the sum of the capitals which families and other groups pass on to heirs (Flora et al. 2015).

Social capital requires a lengthier definition. Social relationships are a source of capital

because they require investments and carry the expectation of future benefits. Definitions of social capital in the community development literature are bountiful, but commonly include aspects of social structure (trust, norms—especially norms of reciprocity—, and social relationships) that facilitate collective action (Green and Haines 2011). We used Green and Haines' (2011) definition of social capital, which emphasized its role in communities of place, as trust and norms of reciprocity were shown to have been spatially and temporally constrained. The concept of norms is a challenging one, but, "In short, they [norms] depend on routine and consistent relationship between place and social interaction" (Bridger and Alter 2006). Social capital includes both emotional and instrumental support, including advice, encouragement and friendship, as well as information and tangible services such as technical knowledge and access to financing (Green and Haines 2011). In the literature on agroforestry adoption, the most important forms of social capital included institutionally-mediated support (e.g. technical support, information, and financial incentive/cost share), and place-based social networks (e.g. knowing someone who practiced agroforestry or hearing NRPs discuss it).

Rural communities may be characterized by what has been lost throughout the 20th century: industries, jobs, population, and educated young people; we instead focused on forest-based strategies that attract capital in multiple forms (Emery and Flora 2006; Bailey et al. 2014; Flora et al. 2015). Emery and Flora (2006) mapped the systems' effects of increasing capitals by depicting the upward spiral of community assets. Their model is based on the inverse of Myrdal's theory of cumulative causation (1957), which states that "the place that loses assets, for whatever reason, will continue to lose them through system effects."

We applied the SLA and CCF to the context of silvopasture managers in the Southeast and the role that national resource professionals (NRPs) play in enabling or constraining

landowners' ability to use silvopasture as a strategy in pursuit of their objectives. Evaluating the upward spiral of assets aids in the conceptualization and interpretation of successful silvopasture systems. Analyzing agroforestry as a livelihood strategy in the southeastern U.S. was appropriate because it is a diversified land use activity (and thus dynamic and context-responsive), is employed to respond to contextual stresses, and while heavily influenced by contextual factors (including institutional patterns and processes and commodities markets), it is a household-based activity that draws from and generates from several categories of resources, including human, natural, financial, and social. Expanding our view to the community-level, we identified collective asset losses and gains with regard to silvopasture in Alabama communities. We reviewed agroforestry adoption literature, including published studies based on quantitative surveys of landowners and NRPs with regard to temperate agroforestry. We extracted salient variables from the literature and grouped them by topic according to the SLA (Gold and Hanover 1987; Lawrence et al. 1992; Lawrence and Hardesty 1992; Matthews et al. 1993; Zinkhan and Mercer 1996; Zinkhan 1996; Workman et al. 2003; Workman et al. 2003; Strong and Jacobson 2006; Calle et al. 2013).

Our objective was to elucidate the breadth and depth of landowner and NRPs' attitudes, practices, information needs, appropriate sources of information, and technical assistance needs in order to answer the following research questions:

1. Which capitals influenced landowners to adopt the practice of silvopasture?
2. Which capitals did NRPs consider when choosing whether or not to recommend silvopasture to a particular landowner?

3. What capitals flowed between NRPs and NRP organizations (cooperative extension, Natural Resource Conservation Service [NRCS]) and landowners, which influence landowners' and communities' silvopasture-related capital accumulation?

Description of methods

To answer our research questions, we designed a case study of silvopasture managers and the NRPs they engaged. Following Yin (2013), we analyzed evidence from three sources: researcher observations during silvopasture field days; educational materials, organizational websites, and other found data; and qualitative, semi-structured interviews with silvopasture managers and NRPs. From a literature review of temperate agroforestry adoption studies, we developed open-ended interview questions with the goal of gathering data on landowner and NRP perceptions and opinions on topics such as where and how landowners and NRPs learn about silvopasture, landowner and site and stand characteristics that influence silvopasture management, with special regard to landowner objectives and contextual factors landowners and NRPs deemed relevant. The ways in which individuals and NRPs perceived and influenced one another were of particular interest to us.

Using the open-ended questions developed during the literature review, we conducted semi-structured qualitative interviews with individual Alabama landowners and NRPs between April and December 2014. Residing, managing land, and working across Alabama and West Georgia, these individuals were employed by organizations such as land management companies, Alabama Cooperative Extension Service (ACES), the Natural Resources Conservation Service (NRCS) state and field offices, and included registered foresters employed by state agencies and private consulting foresters. Eight landowners and nine NRPs participated in interviews, with three individuals falling into both categories (e.g. a forester who also

managed part of his own land in a silvopasture). While developing our recruitment list and conducting interviews, we realized that some silvopastures were managed not by landowners themselves but by their land managers. We classified these employees or contracted professionals as landowners because they were in the decision-making role and actively managed the silvopasture.

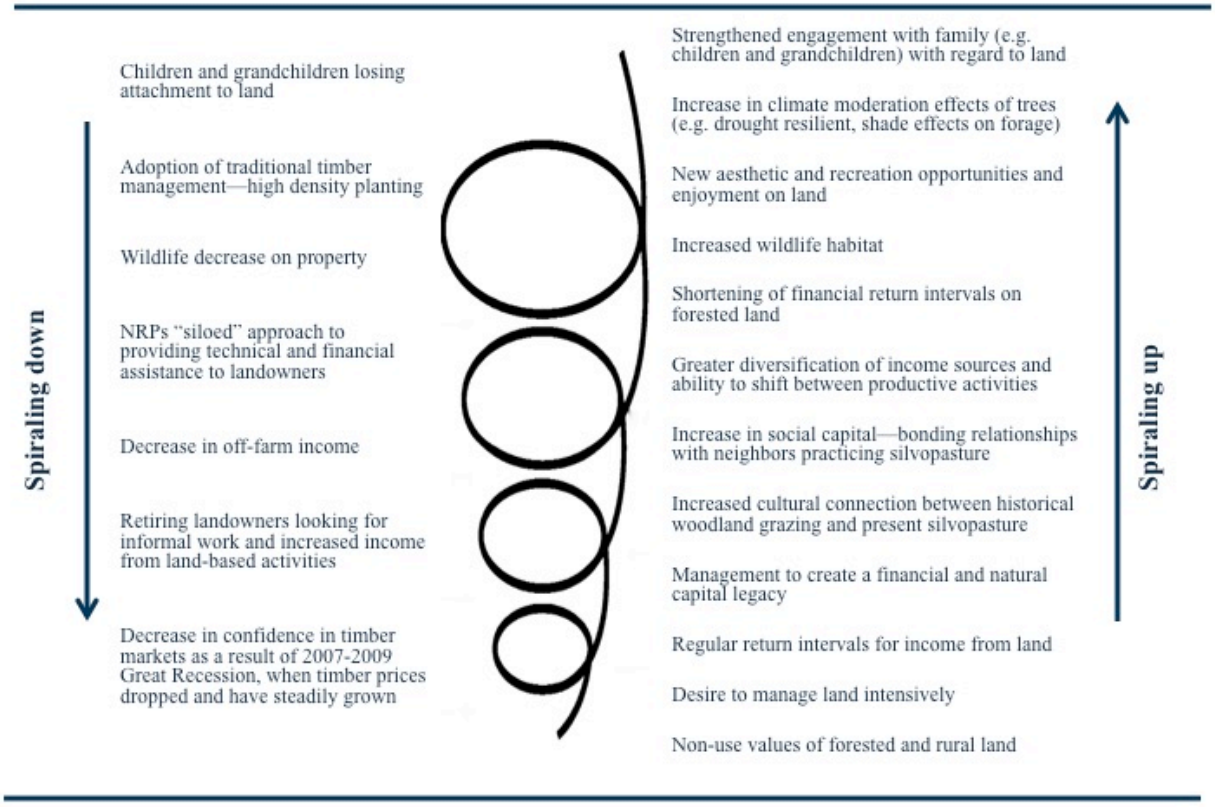
Interview data was based on small, nonrandom samples drawn from professional contacts of the researchers and referrals provided by interview participants, a technique known as snowball sampling (Berg 2009). To reduce potential bias inherent in this sampling technique, we used unobtrusive measures such as conducting some interviewing in neutral settings and we made our intentions clear during initial contacts and through the consent process (Miles et al. 2013). One unavoidable potential source of bias was our affiliation with Auburn University and ACES. Possible ramifications included participants providing responses they believed to be in line with researchers' views and responding in a way that they believe to preserve their self-interest, as many tangible and intangible benefits result from a positive relationship with cooperative extension agents and Auburn University's School of Forestry and Wildlife Sciences. Related to both snowball sampling and potential sources of bias is the historical and present racially-divided extension activities of Alabama's three land grant universities: Auburn University, Alabama A&M, and Tuskegee University. While our university affiliation and contacts facilitated contact with White silvopasture managers who managed cattle in silvopasture, snowball sampling did not lead to African-American silvopasture managers, who mostly manage goats in silvopasture, and whose extension and land grant university affiliations include Alabama A&M and Tuskegee University. This limitation of our research demands that extrapolation of our results to African-American silvopasture managers is inappropriate.

After obtaining informed consent, interviews lasted between 20 minutes and 4 hours. Several interviews with landowners involved a tour of the land in silvopasture. Interviews were audio recorded and later transcribed by the interviewer and thematically coded based on the SLA using NVivo 10 software (2014b). We achieved thematic satiation and coding check by peers confirmed the reliability of our coding scheme. Themes from interview responses and other found data were grouped and analyzed by theme according to the SLA (figure 1) (Chambers and Conway 1991; Scoones 1998) and the CCF (figure 2) (Emery and Flora 2006; Flora et al. 2015).

Findings

Consistent with Emery & Flora (2006), our results (figure 3) showed the attractive nature of capitals at both the landowner and community levels: a downward spiral of multiple forms of value may be reversed through concerted expansion of social and human capitals related to silvopasture (Bridger and Alter 2006; Emery and Flora 2006; Green and Haines 2011).

Figure 3. Household and individual downward and upward spiraling of pivotal capitals for silvopasture: an expansion of Sustainable Livelihoods Analysis for silvopasture



Vulnerability context

Landowners saw silvopasture mediating regular, relatively predictable vulnerabilities such as drought, but saw no benefit to silvopasture in relation to shocks (e.g. hurricanes which threaten timber stands in the Coastal Plain region). One landowner remembered that on a percentage basis, he lost as much timber to Hurricane Opal in the silvopasture as he did in his longleaf planted in a traditional arrangement. Additionally, NRPs in North Alabama expressed a loss of confidence in timber markets in the wake of a recent timber mill closure, which was an economic shock.

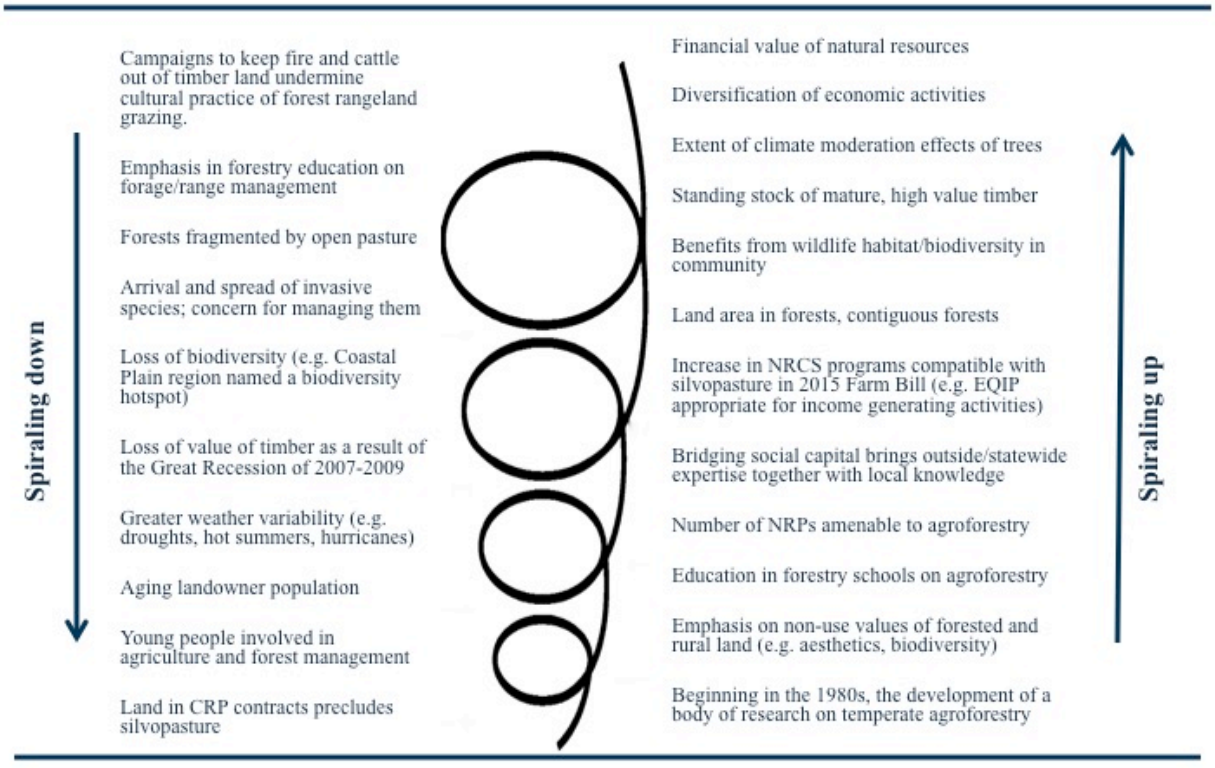
However, for seasonal variation or multi-year trends (e.g. commodity market prices, droughts), silvopasture reduced vulnerability to relatively predictable fluctuations of natural capital (see table 1). One landowner described the silvopasture looking better in dry summer than his field pasture, saying, “In the middle of the summer that is what I look at. They just seem baked out there in the field unless you get a good rain on them.” Another described a rotational grazing silvopasture’s response to a multi-year drought, where, during the worst of it, the silvopasture was “the only place in the county that I think had grass, it was a drought, because he was rotating the cows through there and everybody else was brown dirt.” An NRP explained why the silvopasture preserved soil moisture and forage health: “During droughts, shade can have a big benefit because it helps prevent evaporation and prolong the growth of cool season grasses.”

An additional trend is the growing concern of managing invasive species. Grazing livestock in timberland is a management strategy for the control of invasive species. One NRP said, emphasizing the contrast to the historical directive to get cattle out of the woods, “Look at how now they are all for putting cattle back in the woods…because of the invasive species coming in.” Citing a local timber company that is using longhorn cattle to manage invasive plants, he also listed invasive species he believes cattle eat: Japanese climbing fern (*Lygodium japonicum*), privet (*Ligustrum spp*.), yaupon (*Ilex vomitoria*), kudzu (*Pueraria lobata*), and Chinese Golden bamboo (*Phyllostachys aurea)*.

Strong cattle markets and timber markets, which have improved following the 2008 Financial Crisis, are trends that form a positive context for silvopasture in areas where timber markets are improving (Table 1). Market fluctuation was closely tied to the desired financial capital outcome of economic diversification. Timber markets were perceived by a few NRPs as regional; those who lived near the mill that recently closed saw timber as a liability. One NRP

asked, “So what's the value of timber? It's been in the tank for a long time and in this area the processing plant [paper company] that shut down; so you're sitting here in some pine trees right now what the heck are you going to do with them?” Another NRP emphasized the return to cattle grazing the forests spurred on by high cattle prices: “You probably got some folks in south Alabama used to think all timber now beef prices are good--not good but great--so sure there are people who are thinking now we might go back toward the cattle under [the trees] now that the prices are so good.” Several landowners and NRPs report doing just that.

Figure 4 Community downward and upward spiraling of pivotal capitals for silvopasture: an expansion of Emery and Flora's (2006) Community Capitals Framework for silvopasture



Human Capital

Information and learning about silvopasture

Landowners who are not also NRPs learned about silvopasture in a variety of ways: through reading printed material, by attending silvopasture field days or demonstrations, or through face-to-face education with their local ACES agent or NRCS agent. Thus, increases in human capital are coupled with social capital (relationships with NRPs). In particular, the information source cited by the most NRPs is the publication *Silvopasture: Establishment and Management Principles* as especially helpful (Hamilton 2008). Two NRPs said that they keep copies on hand to give to landowners.

Landowners did not receive information via the internet (e.g. internet videos, publications on government or private websites). However, those landowners who were also NRPs report a higher level of learning via the internet though many still prefer print material. Yet, the ability to synthesize and apply information sources is a concern of one NRPs, who said, after describing information sources including the NRCS and the National Agroforestry Center (NAC), "There is information out there, it's just whether people are willing to research it and if they can understand it once they research it." Explaining silvopasture, especially the combination of components NRPs commonly work with separately, is one of the main benefits of silvopasture training for generalist NRPs (e.g. NRCS district conservationists and county coordinators). This was summed up by one NRCS district conservationist, "You're just taking things that you already know about such as raising cows and then grass and then pine trees and combining them…it starts with rotational grazing, and stocking rates, those things are very similar to if there weren't any trees out there. So it doesn't really change our perspective on that, it's just making you aware of it."

Landowner characteristics and site's natural capital linked

When asked to describe the ideal situation for a silvopasture, both the site and the characteristics of the landowner, NRPs and landowners gave conflicting descriptions. For one NRP, an ideal scenario for silvopasture is a recently retired landowner who has some land in cows and some in pasture, who currently manages cows, and the timber is 12-15 years old, and was planted on an old agriculture site. For another NRP, planting pines in an old pasture is ideal for a cattle producer for several reasons, including the multiple income streams, natural capital goals such as wildlife habitat, and benefits to the cattle, including shade.

Several NRPs mentioned that the ideal person to adopt silvopasture has experience with cattle as well as land in timber. A registered forester (RF) and silvopasture manager who grew up with cows communicated how much he enjoyed working with both trees and cows. When he was exposed to silvopasture as a forestry student, "It piqued my interest because we've got cows and I've always been around cattle. It brought together two things that I've always liked."

Age of landowner

The age of landowners who are in a good position to succeed with silvopasture is, as one NRP described it, "old, but not too old." An NRP who has helped several landowners expand their pastures into thinned timberland believes that silvopasture is ideal for a recently retired individual who has "managed cattle as a hobby, and expand it more," because silvopasture can provide extra income for individuals who have newly freed-up time to devote to expanding their cattle herds and managing more intensively. Landowners who are in this age category remarked that they enjoyed learning about silvopasture. Here is a crucial link between human and financial, as well as natural capital, as landowners articulated that their management decisions, and the trees they planted will outlive them. Many NRPs and landowners were concerned that

the aging landowner population is not being replaced by a new generation of interested and involved young landowners, saying, “Most of their kids and grandkids are going to [work at] a plant, which is an indicator of a serious problem that I see in these parts.” He believes that this age gap undermines the effectiveness of extension programming. “I’ve been here for 38 years, and most of those cattlemen have been to 30 to 40 programs I’ve done during that time…what would be ideal, I’d say if we had 20-30 couples that are 20-30 years old going into the cattle business that haven’t heard that same speech 20 times.”

Management intensity

One North Alabama NRP believed that the natural capital base would support silvopasture success, but the limiting factor is the cultural or human capital investment required. He said, “They’re not going to commit the time to do what I think they need to do to make it work. I mean, it could work up here because this is a big fescue (a forage crop) growing area, so we have the forages to work with it if we could just get the farmers to look at it from the timber standpoint but I don’t know if that could happen.” This lack of time is attributable to the prioritization of off-farm work. “The biggest problem I have in working with them is that most of them are part-time farmers. They work at a plant on the river up here and they part-time farm, which, until cattle prices got so good, they just sort of half way paid attention to their cattle. They work their job, then come home and look, ‘Yeah, cows are in the pasture and not in the middle of the road.’ That’s kind of how they treat their cattle and their timber, here, for that matter. Down in south Alabama they have their pine plantations and they really pay attention to their timber.”

Desire to intensify

Several NRPs and landowners referenced intensifying: "getting the most out of your property." Two NRPs specifically mentioned desiring to use land more intensively after seeing multi-use and highly productive agroforestry systems abroad. One ACES county coordinator saw silvopasture in Brazil on a cattle tour and one NRCS state employee saw it and other agroforestry systems while traveling to tropical regions. He said, "I've seen where other kind of [developing] countries fully utilize the land for all that they can: fruit trees, nuts, cattle, they are just doing everything on every little piece of land they can because it is their survival. In Alabama we seem to have timber or cattle and it's like we are just going to make a go of it with this big operation or that big operation and we are not really fully utilizing the land like it could be used."

The fact that silvopasture is an intensively-managed system makes it inappropriate for many landowners; for example, those who do not have the time to devote to learning about it or implementing it will not benefit. One landowner previously managed his silvopasture in an intensive, rotational grazing system, moving cattle between paddocks weekly, but currently grazes the whole pasture, a less intensive method.

For one landowner and RF, shifting economic realities necessitated the intensification of the land he manages: "Operating budgets are going down so we've got to figure out a way to maximize every resource that we can, so we started asking, 'what gets you the most bang for your buck? Is it the conventional 600 trees per acre (TPA) set or is it the silvopasture set where you're doing 350 trees that you're continuing to harvest?'"

Natural capital

Wildlife

Many participants expressed interest in the spatial arrangement of the silvopasture for wildlife habitat. The arrangement of trees in a silvopasture, with wide spacing between closely planted rows of trees, provided forest structure variability (specifically, more cover and edges) and essential cover for wildlife. For example, one landowner stated, "Open alleyways give them a sense of security. The turkeys are out there bugging and the deer will use it to travel." This quality mattered to landowners who lived on their property and enjoyed viewing turkey and deer from their porches and to NRPs whose private landowners manage for wildlife habitat, some of whom profit from hunting leases. One land manager remarked that the areas with silvopasture were the most sought after by turkey hunters. One ACES extension agent was interested in the potential for the use of mast-producing trees in silvopastures for wildlife food. Similarly, a landowner mentioned that he was considering producing hogs in his hardwood forest, and wondered if that was a type of silvopasture. For those with a negative opinion of silvopasture, low density planting appeared to be wasted light on the ground to foresters and impediments to forage volume to cattle producers. But for individuals interested in wildlife habitat creation, the spatial arrangement advanced their objectives.

Shade

Shade created by the pines in the overstory had measurable impacts on forage and on the comfort of cattle, especially during extremes in weather conditions. One respondent stated, "I'm convinced you get better forages under trees…it's cooler; it just seems to be more lush than the ones out in the middle of the field [that] get direct sunlight on them, and they look, especially in a drought when it's dry, they just look baked [while] the stuff out here is just lush." Another

respondent explained the protective effect of trees stating, “During droughts, shade can have a big benefit because it helps prevent evaporation and prolongs the growth of cool season grasses.” As cattle graze a whole pasture more evenly and congregate less under a few scattered trees, they impact the nutritional value of forage by redistributing waste, improving soil and forage performance. One ACES livestock specialist emphasized the benefit of silvopasture for cattle waste distribution.

Trees and the shade they provide have positive impacts on cattle—both how they feel and behave in their pastoral environment. One participant said, “When it gets into the hot summer if they get flies on their back there’s nothing to be any better than pine tree to get and walk under to get their flies off their back and their face.” The disbursement of cattle grazing in a field is in contrast to a common sight in the open pastures of the Southeast during the hot summer months. He added, “The cow is going to find the shade. If there is one tree they’re going to be laying against each other under it.” When the shade is dispersed, he said, “The cattle are willing to spread out.” Other than in their silvopastures, several respondents described technical means of providing shade to cattle, such as fenced-off areas under the cover of trees by a low-lying area or stretching shade cloth over metal frames in the pasture. However, not all livestock producers are tuned into the need for shade. One NRP lamented that in his experience, “Livestock producers are set in their ways…and are not looking for shade benefits.”

Financial capital

Many of the motivations landowners reported for adopting agroforestry related to economic and financial capital, and specifically, to the diversification of economic activities.

The opportunity for increased agility by prioritizing multiple marketable products and income streams on different schedules is by far the most attractive livelihoods outcome.

Correspondingly, the most pressing questions NRPs voiced related to the financial viability of silvopasture. On a site that previously managed for timber, cattle leases, and hunting leases, the land manager has found that by changing from open pasture to silvopastures, he has multiple incomes from his previously open pasture. Now, these are sought-after hunting spots because of the increased wildlife habitat, as well as the future timber income. Some landowners who already had diversified land uses described shifting their productive activities with silvopasture by thinning existing forested land to a canopy density to support forage production in order to expand their grazing land and size of their cattle herd and capitalize on currently high cattle prices.

To NRPs familiar with the timber business, silvopasture was viewed positively, especially with regards to return intervals. A consulting forester said, "Well, to my preference, (economic return intervals with silvopasture) are a lot more sustainable. You've got a yearly return and then you've got a 15 year timber return, so to me that's a no-brainer." Related to the timing of timber harvests (and subsequent income), a few landowners explicitly stated that they did not expect to see the economic benefit of the timber investment in their lifetimes but anticipated that their children or grandchildren would reap the rewards of their activities in the form of high-value timber product classes while the annual income from livestock and pine straw harvest were their personal benefits, thus linking financial, natural capital, and human capital/legacy goals. This is consistent with Dyer et al. (2015)'s findings about factors landowners consider when making decisions and the importance of reasons that would lead them to consider practicing agroforestry. They found that 54 % of Alabama landowners surveyed report that "leaving a legacy for heirs" is "very important" with 28 % more rating this as "somewhat important." Simultaneously, landowners rank natural capital benefits (improving

wildlife habitat; soil conservation) and financial capital benefits (increased land value) as the top three important reasons to practice agroforestry (Dyer et al., 2015). Along those lines, several landowners and NRPs mentioned appreciating that if timed correctly, livestock grazing is compatible with pine straw harvesting, a financially lucrative non-timber forest product (NTFP). In contrast, a forage and livestock NRP was pessimistic about the utility of silvopasture. He said, "I don't foresee [silvopasture] ever becoming an economic and widespread economically viable practice because I don't think pine trees are worth anything." This statement was underscored by his observation of a recent timber mill closure in his area.

Social capital and transforming structures and processes

Our results supported Green and Haines' (2011) claim that social capital is a prerequisite to generating growth of human, financial, physical, and environmental capital. The most important example of social capital mentioned was knowing or acquaintance with one or more silvopasture managers. "If one of their friends do it and it works then they're more likely to do it than if the professor is saying, 'hey, this would be a good idea.'" As evidenced by this response, the landowner must have perceived that the individual recommending silvopasture was in a similar situation in order to believe silvopasture was a viable land management option, consistent with the theory of bonding social capital. NRPs reported that knowing silvopasture managers was a primary method of learning about silvopasture, and strongly influenced their perceptions. Still, respected local NRPs were important sources of social capital for landowners who had decided to take a closer look at silvopasture as well as for NRPs looking for information from professional peers outside their area of expertise. Thus, bonding social capital was important to both landowners and NRPs, and bridging social capital allowed landowners to access knowledgeable NRPs through the neighbors and NRPs they already knew through relationships

of bonding social capital. Conversely, in areas where NRPs did not know silvopasture managers and in regions where norms dictated that cattle and timber occupied distinct tracts of land, social capital worked to exclude silvopasture as a land use option. This is a situation where increasing the weak ties between NRPs who support landowners doing silvopasture will spiral up, accumulating other community capitals: human, financial, and environmental (Emery and Flora 2006).

When we asked landowners and NRPs who landowners needed to be in contact with to gather information or receive information about silvopasture, the most common answer was the NRCS. As the NRCS mediates financial resources from the USDA, bridging social capital relationships permits access to financial capital, including funds specified for built capital. One RF and landowner listed ACES agents, NRCS professionals at local branch offices, and registered foresters. However, he gave the caveat that RFs are less likely to advise a landowner on silvopasture. He said, "I think a lot of your registered foresters and foresters in general, I do not think that they push [silvopasture]. It's more of a conventional set mindset, primarily loblolly pine for this area. Everybody wants to do loblolly pine." Here, bonding social capital among RFs appears to be strong, compromising the bridging social capital relationships between RFs and other professional NRPs such as Cooperative Extension agents and NRCS conservationists. "I don't really think that there's enough push by that facet of the forestry industry to really do any good [with advising landowners on silvopasture or other agroforestry practices]. I think it's going to be Extension and NRCS." ACES and NRCS may play a particular role in facilitating experiential opportunities such as field days and demonstrations, which in addition to fostering learning, also promote interpersonal connections between individuals (both landowners and

NRPs). “These farmer field days: I think that’s so important, to have a short one-day course to let them come out and see for themselves.”

Minority landowners

Several NRPs mentioned that they have heard silvopasture discussed as a land management option for minority landowners. One cited a professor at Alabama A&M who primarily works with minority landowners on silvopasture establishment. The vulnerability context is particularly acute for minority and limited resource landowners in the Southeast who manage small landholdings and reside on-farm. Silvopasture, with its associated multiple income streams and high labor inputs, may be appropriate for minority landowners who are especially vulnerable to contextual factors. Another spoke more pointedly about how the positioning or framing of silvopasture as a land management system for minority and limited resource landowners has constrained the adoption of silvopasture for other landowner groups. “It kind of got put over here in this outreach kind of scenario and stayed there I think for several years it never quite got out of that box--this is something that minority landowners should be involved with but the regular real-world forestry out here it doesn't apply--so for years I think it stayed there.” In this way, he indicated his feeling that silvopasture was not reputed to be profitable or a good option for resource-endowed landowners.

Table 1 Summary of landowner- and NRP-identified capital changes related to silvopasture

Human	Retired landowners enjoy learning, informal and self-directed work, physical/outdoor activity
	Landowners report greater satisfaction in land (i.e. aesthetic appreciation and recreation opportunities, including hunting)
	NRPs’ skill set expanded as they are trained in and provide assistance with silvopasture
	Landowner familiarity and learning about silvopasture
	Landowners with the desire to manage land intensively are doing so

	Younger NRPs report education in forestry schools on agroforestry
	Beginning in the 1980s, the development of a body of research on temperate agroforestry
	Silvopasture reinforces landowners' strongly-held values as they manage silvopastures to create a financial and natural legacy
Social	Management intensity and legacy values mean greater engagement with family (e.g. children and grandchildren) with regard to land
	Increase in NRPs trained in providing silvopasture assistance
	NRPs less "siloed" in approach to providing technical and financial assistance to landowners
	Increased bonding relationships between NRPs across areas of work and professional affiliation (e.g. cooperative extension and NRCS)
	Increase in bonding relationships between neighbors practicing silvopasture
	Bridging social capital brings outside/statewide expertise together with local knowledge, both landowners and local NRPs
Political	Recent NRCS financial assistance programs approved use with silvopasture in 2015 Farm Bill (e.g. EQIP appropriate for income generating activities, in contrast to a previous program, CRP)
	NRPs amenable to combining forestry and agriculture
	Landowners' observations and objectives are transmitted through NRP channels to state and regional political centers through bridging social capital
Financial	Increase in frequency of financial return intervals on forested land
	Increase in diversification of income sources (especially important given decreased value of timber following the 2007-2009 Great Recession)
	Increase in standing financial value of natural resources (including mature, high-value timber, wildlife)
	Increase in diversification of economic activities
	Landowners capture benefit of current high cattle prices
Natural	Ameliorative effects of previously destructive land use practices (e.g. row crop agriculture), "build land back up"
	Climate moderation effects of trees (e.g. shade effects on forage)
	Expanded wildlife habitat (including game and non-game species)
	Greater standing stock of mature, high value timber
	Climate moderation effects of trees
	More contiguous forests and total forested land
	Protection from extreme weather (e.g. droughts and hot summers, hurricanes)
	Livestock manage invasive species
	Shade from trees makes livestock more comfortable in hot summers
Cultural	Return to forest structure akin to historical ecosystems after several decades of high-density timber management
	Increased cultural connection between historical woodland grazing and silvopasture
	Silvopasture combines two culturally-acceptable income-generating practices (especially important after decreased timber values following the Great Recession of 2007-2009)

Strengthening rural identity of landowners and family (e.g. children and grandchildren)
Increase in non-use values of forested and rural land (e.g. aesthetics, biodiversity preservation)

Analysis

Vulnerability Context

As a diversified management system, silvopasture is also a risk-management strategy, and landowners and NRPs alike see silvopasture as mediating the vulnerability context (Figure 1, section A). Many landowners who considered silvopasture were interested in mitigating environmental and economic risk. Gold and Hanover (1987) identified four categories of risk factors that agroforestry practices mediate: market, biological, fire, and seasonality (e.g. agroforestry practices allow landowners to make fuller use of farm labor during slack periods). From an economic perspective, trends in silvopasture are closely tied to prices of cattle, land, and labor. According to Boyer (1967), "When cattle prices rise, greater interest is shown in using forest forage for livestock production. On the other hand, rising labor and land costs force some owners to sell out or cease to make the needed investments for production of livestock on forested lands." Trends in timber and cattle markets drive silvopasture decision making, either by incentivizing landowners with cattle and timber to expand their grazing land and herds into their timberland, or to consider adding cattle production to their land management activities. The vulnerability context of the SLA is especially relevant to agroforestry, given the importance that agroforestry-interested landowners place on product diversification, shifting between profitable land uses in response to markets, and reducing their economic risk. In this way, silvopasture is

consistent with a goal of community development, to make local economies less vulnerable to changes in markets (Green and Haines 2011).

Social capital

Our findings indicated that bridging social capital relationships between landowners and NRPs led to the growth of several capitals. Particularly important were the relationships of NRPs from multiple focus areas and across professional associations (e.g. an RF in conversation with an ACES forestry agent). One NRP explained that when he first heard about silvopasture, he had a very low opinion of it, but as he met more NRPs who shared landowners' successes with the practice and he grew to see how his understanding of forestry was congruous with silvopasture, he has recommended it to multiple landowners. We also heard from local, generalist ACES agents and NRCS conservationists who called on state and regional ACES and NRCS agents to support them in assisting landowners with silvopasture. This is consistent with Emery & Flora's (2006) finding that bridging social capital played a vital role in developing human capital and social capital by bringing together outside technical expertise with local leaders with knowledge of place. Overt investments in human, financial, and social capitals resulted in the increase in multiple capitals (Emery and Flora 2006).

Overwhelmingly, NRPs understood their role to be assisting landowners by providing information and technical support, and in the case of NRCS conservationists, technical and financial means; this role is consistent with the technical assistance approach to community development (Sakamoto and Hustedde 2008; Green and Haines 2011). However, few NRPs strongly identified a bridging social capital role, offering connections to landowners to other NRPs, through weak ties that bind NRPs across a state or region (Bridger and Alter 2006; Green and Haines 2011; Flora et al. 2015). They primarily saw themselves as occupying a linking

social capital role, where they facilitate local landowners' access to external organization (e.g. the NRCS, Auburn's SFWS, ACES) and the information and resources located there (Woolcock 1998; Bridger and Alter 2006). Since landowners' learning curve is steep, we identified the need for NRP organizations wishing to facilitate silvopasture learning to incentivize their local NRPs to build relationships with multiple actors: bridging relationships with experienced silvopasture managers and NRPs with other specialties and linking relationships across organizations, which is an expansion of the role they see for themselves. This is particularly important because the educational background and professional specialties of the NRPs greatly influenced on which aspects of silvopasture they put the most importance. Silvopasture-focused NRPs proficient in balancing all components (timber, forage and livestock) can facilitate the landowner's relationship with NRPs with specialties in particular components. For example, NRPs with a background in forages stressed forage management in a silvopasture, and the responses of forage to the presence of trees and shade, while NRPs with forestry backgrounds were most interested in preventing livestock from damaging young trees in a silvopasture. This emphasis was unsurprising, but it highlighted the need for collaboration between NRPs of multiple specialties to address fully the intensification and increased complexity that comes from combining multiple objectives in land management and meet the information and technical needs of landowners managing silvopastures.

Human and natural capital

The community development literature often differentiates between place-based policies and programs and people-based approaches (Green and Haines 2011). However, our findings underscored that people or place is a false choice and that landowner objectives, regional land

use history, natural capital resources all combine to situate a silvopasture as acceptable to both a particular people and place.

In fact, our results indicated that landowners were not interested in silvopasture per se but interested in a land use that is culturally appropriate and congruous with their objectives and site characteristics, finding silvopasture to fit their social milieu. We advocate for communication related to agroforestry practices to be tailored to environmental and social context. Landowners' human capital and legacy objectives, in particular, made the environmental, aesthetic, and financial benefits of silvopasture particularly appealing. This explanation supported many findings about landowners who practice silvopasture, including their tendency to be situated in regions where cattle had historically grazed the woods, and legacy desires to leave the land healthier than they found it and invest now in land uses that will benefit future generations financially. Similarly, in regions where combining trees and cattle was culturally unacceptable, landowners looked to other options for meeting their objectives.

None of the landowners we interviewed derived their income solely from on-farm activities. However, they were interested in making part of their income from land uses they find meaningful in other ways: for aesthetic appeal, recreation, and wildlife habitat creation, as well as choosing a land use that creates a legacy for future generations, in natural capital and financial terms, and as tied up in culture and human capital (Flora et al. 2015). This explanation for these important results emerged from the application of the SLA and CCF, and reinforced the principle that these people-centered approaches to community development emphasize diverse productive activities (Gutierrez-Montes et al. 2009). Landowners' practice of silvopasture and NRPs' observations and feedback from landowners and other NRPs worked to reinforce and solidify the way that both landowners and NRPs came to view themselves and their forested land differently

(Emery and Flora 2006). An NRP forester expressed this transformation when he described the work he did as supporting the development of the whole land and using his timber-production knowledge by helping landowners achieve goals that included growing timber, but included other goals he previously saw as outside his scope of work.

NRPs, who primarily evaluated silvopasture relative to economic returns of other land uses, needed stronger training in listening to and supporting landowners' diverse goals for their land management. This represents a major shift within modern forestry, in particular. Additionally, natural resources CBOs should consider developing suites of land uses that align with community culture and train their NRPs to aid individual landowners in evaluating their site and circumstances in order to generate multiple capitals. Our results indicated that a prerequisite social capital for silvopasture is a spatially local norm of comingling cattle and timber, especially where there is a historical precedent.

The landowners who chose silvopasture used non-priced use values (e.g. wildlife habitat creation, recreation, and hunting), non-use values (e.g. aesthetics, creating a legacy for heirs), and projected financial returns (priced use values) as criteria for evaluating land use options. Overwhelmingly, landowners commented on the enjoyment they found in managing their silvopastures. On the other hand, NRPs emphasized their view of the financial viability of silvopasture—echoing a longstanding, polarizing debate within NRPs.

In terms of the landowner and site characteristics (Figure 1 section C and D), several NRPs employed with the NRCS saw that the time was ripe for silvopasture for a particular group to diversify and intensify timber stands to include livestock production: individuals with NRCS-administrated contracts nearing expiration with the Conservation Reserve Program (CRP). While the CRP explicitly precludes grazing, NRCS conservationists commented on the ability to

transition from a stand of timber planted at the beginning of a CRP contract to a silvopasture of widely-spaced timber with an eye toward managing for high-value timber product classes, providing long-term income and short-term income from livestock. The NRCS oversees additional cost-share funding appropriate for reducing the financial cost of transforming a CRP-planted timber stand to a silvopasture. Cost-share financial support was consistently identified as a variable enabling agroforestry; conversely, lack of financial incentive is a constraining variable (Dyer, 2012; Strong & Jacobson, 2006; Workman et al., 2003; F. C. Zinkhan & Mercer, 1996; F. Christian Zinkhan, 1996). The Environmental Quality Incentives Program (EQIP), a part of the 2014 Farm Bill, is available to Alabama landowners for cross fencing, water systems for livestock, and establishing forage grasses along with the technical information and assistance of NRCS conservationists. A major barrier to the application of silvopasture as an option for expiring CRP contracts was the assumption of NRCS conservationists that many landowners are not interested in planning land management past their CRP contract expiration. Top-down (e.g. state- or federal-level communication from NRCS and the NAC) is needed to detail the relevant policies and process of creating a silvopasture from a previous CRP and disseminate the information. This CRP to EQIP transformation represents an unprecedented opportunity to communicate the benefits of silvopasture to a targeted audience whose current land characteristics make silvopasture a viable option. Coupled with the record-high prices cattle are demanding at market (2015), silvopasture is a timely land use.

Conclusions/Recommendations

In this study we identified important human and social capital needs that influence the ability of landowners to accrue desired capitals: silvopasture-specific technical assistance, as well as assistance from forestry, forage, and livestock specialist NRPs. Future studies should address the

needs of NRPs related to silvopasture and include a survey directed to NRPs in the southeastern U.S. to understand natural resource professionals' knowledge, perceptions, and recommendation of silvopasture to private landowners. Results discussed here identify target groups of landowners who may be in the best position to succeed at silvopasture based on the stocks of community capitals in a given area, namely, in regions (e.g. the Coastal Plain) where the combination of cattle and trees is culturally acceptable. In particular, we recommend an immediate and targeted effort to communicate the option of silvopasture to landowners with expiring CRP contracts who may be enticed by the EQIP cost-share available for establishing silvopastures. Additionally, landowners who express interest in pine straw harvesting may be candidates for silvopasture, as they are seeking to enhance their bases of financial and natural capital simultaneously by intensifying their land management. This region-specific approach is distinctly different than the currently common method of introducing the topic of agroforestry to landowners in a newsletter by outlining the five agroforestry practices and providing examples from across the country. Those advising landowners about silvopasture and agroforestry should consider a place-based approach, emphasizing historical land use practices and financial and natural legacy outcomes.

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Chapter 3

Title: Natural resource professionals' familiarity, learning, and perceptions of silvopasture in the southeastern U.S.

Abstract

Natural Resource Professionals (NRPs) are employed by public agencies and privately contracted and are commonly regarded as the front lines of agriculture and forest management innovations, including silvopasture, an agroforestry practice (Zinkhan 1996; Workman et al. 2003; Strong and Jacobson 2006). Through a web survey of NRPs with cooperative extension, Natural Resource Conservation Service, state forestry services, and private foresters in Alabama, Georgia, Mississippi, and Florida, we found that 64 % of respondents are "somewhat" or "very familiar" with silvopasture and 54 % have participated in a silvopasture field day. Rates of silvopasture training were highest for NRPs in the NRCS (78 %) lowest for registered foresters (29 %) ($p < .001$ Chi-square = 55.367) and highest in Alabama (67 %) and Mississippi (63 %), and lowest in Georgia (41 %) ($p < .01$). Perceptions of the physiographic suitability for silvopasture were lowest in Mississippi ($p = .02$; test statistic 14.632; DF =3) The state forestry service NRPs and NRPs in Mississippi and Georgia present strong opportunities for education regarding silvopasture.

Introduction

Agroforestry combines trees with crops and/or livestock, using technical knowledge from agriculture and forestry as well as the unique interactions that result from the integration of the biological components of these systems. Within the five agroforestry practices (alley cropping,

forest farming, riparian buffers, silvopasture, and windbreaks) exist a range of objectives, from water quality enhancement to economic returns, with multiple benefits noted for each agroforestry practice (Garrett 2009). In the southeastern U.S., silvopasture is the most commonly practiced integration of trees, crops or forage and livestock. Landowners and natural resource professionals (NRPs) have reported the greatest familiarity with this practice (Zinkhan 1996; Workman et al. 2003).

Silvopasture is intensive management of timber, forage, and livestock for multiple products on a single site. The nuanced management of multiple products (i.e. tree, forage, and livestock) for beneficial interactions among species distinguishes a silvopasture from unmanaged woodland grazing (Hamilton 2008). As a region, the Southeast is well-suited for silvopasture due to its long growing season, existing timber markets, increasing demand for high-quality timber and meat products (e.g. grass fed, humanely raised, locally produced), and the amount of forestland owned by private landowners (Gold and Hanover 1987; Gwin 2009; Cubbage et al. 2012). Southeastern pine species commonly planted in silvopasture include longleaf pine (*Pinus palustris*), shortleaf pine (*Pinus echinata*), slash pine (*Pinus elliottii*) and loblolly pine (*Pinus taeda*) (Hamilton 2008). In a silvopasture system, trees are typically planted or thinned to two or three rows of timber with widely spaced alleyways (9-12 m) in between, and the timber component is managed for high-value timber product classes, (e.g. sawtimber and poles). In some ways, silvopasture is a departure from traditional timber management in its intensity: trees are pruned, thinning is carefully timed, forage growth is monitored, fences are maintained, and frequent management of livestock is required (Hamilton 2008). In their economic analysis of actual field trials of a South Mississippi silvopasture, Grado et al. (2001) found that land expectation values (LEVs) for silvopasture were higher than multiple grazing or forestry

applications alone, except for the steer grazing treatment. They couched their results with some contextual factors: the study location has high physiographic potential for cattle and timber production, and economic returns depended strongly on cow and steer prices, which are variable, though currently at a historic high (USDA 2015). The wildlife habitat silvopasture created and associated income from fee hunting was the primary factor for the superior financial performance of silvopasture over open pasture cow grazing (Grado et al. 2001).

Across the eastern U.S., 81 % of forestland is privately held, with 59.5 million hectares (ha) of forested land in private, non-corporate hands in the southeastern U.S., considerably more than the North (40.5 million ha) and West (16.6 million ha) (USFS 2014b). In a national survey, private landowners have reported that the top reasons they owned forestland were for aesthetic value, to pass on to heirs, as part of a family farm, for recreation and for timber production (Butler 2008). These reasons are all compatible with silvopasture and support research that has found pine silvopasture was well-suited for the southeastern U.S. (Ares et al. 2003; Brauer et al. 2009). In addition, economic analyses have demonstrated that silvopasture may be a viable economic choice for landowners in this region who were interested in a diversified production system with short- and long-term investments (Grado et al. 2001; Nowak et al. 2014).

On a national level, there has been institutional interest in understanding the current practice and science of agroforestry applications. For example, the USDA has undertaken coordinated efforts to promote agroforestry practices for conservation and economic development (USDA 2011) and the Society of American Foresters has highlighted agroforestry as a focus for research presentations in its 2013-2015 national conventions. The USDA's 2012 Census of Agriculture (USDA 2014) included the first-ever question about agroforestry, asking all farm households, "At any time during the previous year, did you practice silvopasture or alley

cropping?" The census yielded 119 farms in Alabama answering "yes" to that question. Alabama tied with North Carolina for 6th place in the total number of farms practicing silvopasture or alley cropping, behind Texas (199), New York (186), Pennsylvania and Missouri (both with 141), and Florida (137) (USDA 2014).

The agroforestry adoption literature has investigated on farmers or landowners who may adopt agroforestry and the NRPs who inform them (Lawrence et al. 1992; Lawrence and Hardesty 1992; Pattanayak et al. 2003; Workman et al. 2003). This emphasis on local professionals has been consistent with research in the adoption-diffusion tradition which points to the positive role that locally active, respected professionals may play in the diffusion of an innovation, including a novel land use (Rogers 2003). Results from the National Woodland Owner Survey have indicated that nationwide, the top sources of advice for landowners have been, in order of importance, state forestry agencies, private consultants, and federal agencies (Butler 2008). Thus, the extent of silvopasture use by landowners is likely paralleled by an accompanying growth in knowledge and communication related to silvopasture on the part of NRPs.

Local experts play a pivotal role in the adoption of agricultural innovations by local farmers and landowners (Rogers and Ban 1963; Rogers 2003). They facilitate learning and serve as conduits for information (Rollins 1993), cultivate and participate in networks of stakeholders, and may channel financial capital to landowners, sometimes simultaneously. The multifaceted nature of silvopasture necessitates collaboration among NRPs possessing a variety of skill sets, backgrounds, and expertise, related to forestry, livestock, forage production, silvopasture, or agricultural economics. For example, facilitating landowner education related to silvopasture by organizing field days on a local silvopasture simultaneously assists networking between NRPs

and landowners and provides a venue to collaborate. Because NRPs participate in professional networks and maintain connections with research universities they are potential sources of bridging social capital between academia and landowners (Flora et al. 2015).

Conversely, NRPs receive information from landowners, including landowner observations and interests which can be used to improve the applicability and quality of research. For silvopasture and all conservation forestry and agriculture practices, NRCS conservationists mediate access to Farm Bill cost share programs (e.g. Environmental Quality Incentives Program [EQIP]) as well as some loans and grants (NRCS 2016).

Because of the important role that NRPs play in dissemination of information, technology, and beliefs about land use innovations, we focused on their role related to silvopasture. Our objective was to learn more about NRPs' familiarity, learning, and perceptions of the suitability of silvopasture. We sought to determine differences in how silvopasture is regarded by NRPs in four southeastern U.S. states: Alabama, Florida, Georgia, and Mississippi, and between four professional affiliations: NRCS conservationists, cooperative extension agents, foresters employed with state agencies, and registered foresters.

Methods

Between April and December 2014, we conducted qualitative interviews with NRPs who were familiar with the practice of silvopasture and landowners who have received advice and technical assistance from NRPs in their process of adopting silvopasture. Based on information gleaned in these interviews, we developed a web-based questionnaire to determine how NRPs regard silvopasture (Appendix 1).

We developed a sample of 1,038 cooperative extension agents, registered foresters, consulting foresters, state forestry services, and NRCS conservationists in four states in the

southeastern U.S.: Alabama, Florida, Georgia, and Mississippi, our population of concern (Appendix 2). Alabama, Florida, Georgia, and Mississippi were selected because they are contiguous to Alabama (the location of the researchers), have similar forestry practices and industries, and are states where much forestland is under private ownership (Butler 2008). Using probability sampling methods, we sampled 80 % of our sampling frame to achieve the sample size needed at the 95 % confidence level to make comparisons between states and professional categories (Dillman et al. 2009). Following Dillman's Tailored Design Method for web-based surveys (2009), we developed a questionnaire that took an estimated 15 minutes to complete.

The survey was conducted via Qualtrics (2014c) and followed research protocol approved by Auburn University's Institutional Review Board (IRB). An initial pre-notice letter on Auburn University School of Forestry and Wildlife Sciences letterhead (Appendix 3) was mailed to the survey sample on November 3, 2014. It described the research project, notified the recipient to anticipate an e-mail containing a web link to the questionnaire, and encouraged participation. Seven days later, e-mails were sent to the sample. The body of the e-mail (Appendix 4) contained a web link to the survey. The first page of the survey contained an information letter which consented respondents (Appendix 1). A follow-up postcard (Appendix 5) was mailed ten days later, thanking those who had already participated and encouraging those who had not responded to do so. Finally, a second e-mail was sent containing a link to the survey and communicating the importance of their participation and our appreciation. Qualtrics monitored the completion of surveys, participants' responses and a list of non-respondents, and exported results to SPSS (2013). Finally, we performed statistical analysis with the survey data. Within SPSS, results were summarized and analyzed using descriptive statistics, cross-tabulations, Chi-square, and Kruskal-Wallis H, with post-hoc pairwise comparisons.

Results

Eleven individuals in our sample actively declined to participate in the survey by e-mail or by returning a blank survey. Of the 1,006 valid recipients, 452 questionnaires were returned, yielding a 45 % response rate. Our response rates by state were 55 % for Alabama; 50 % for Florida; 40 % from Georgia, and 40 % from Mississippi. Three-hundred ninety respondents (390) answered "yes" to the question, "Are you an agricultural or land management professional who gives advice to private landowners or farmers about their management practices and are you over the age of 19?" One respondent actively opted out after beginning the survey, yielding 389 valid, usable responses. Of the 389 valid respondents, 29 % were from Alabama; 19 % were from Florida, 31 % were from Georgia and 22 % were from Mississippi (Table 1).

Conservationists with the NRCS in the four states sampled accounted for 33 % of responses, cooperative extension equaled 32 %, and foresters employed by state forestry services made up 15 % of respondents (Table 1). To round out the participants, registered foresters and members of the Association of Consulting Foresters (individuals with professional mailing addresses listed for the four states) made up 19 % of respondents (Table 1). Since responses by each state and professional affiliation were greater than 30, statistical tests are appropriate (Vaske 2008).

Table 1 Number and percent of survey respondents by professional affiliation and state, 2014 survey of NRPs in four Southeastern states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

	AL		FL		GA		MS		Total	
	N	%	N	%	N	%	N	%	N	%
NRCS	33	8 %	28	7 %	24	6 %	42	11 %	127	33 %
Cooperative Extension	47	12 %	12	3 %	50	13 %	19	5 %	128	33 %
State Forestry Service	7	2 %	25	6 %	15	4 %	13	3 %	60	15 %
Registered Forester	24	6 %	9	2 %	31	8 %	10	3 %	74	19 %
Total	111	29 %	74	19 %	120	31 %	84	22 %	389	100 %

Since our sample included individuals with diverse areas of primary responsibility (e.g. livestock, farm business management, wildlife), we were interested in the areas of work of respondents. Unfortunately, we were unable to draw conclusions due to the high percentage of respondents selecting "other" (33 % of NRCS conservationists and 30 % of cooperative extension agents, providing answers including "blueberries, agronomy, fisheries, all of the above, and rural appraisal"). This is due to the nature of their positions. Programming areas of NRCS conservationists and extension agents are diverse (e.g. natural resources, row crops, horticulture, livestock, farm business management, and "other,") while forestry is the focus of almost all in the state forestry service and registered foresters categories.

Two demographic characteristics of respondents were noteworthy: age and gender. Overall, age distributions of NRPs employed by government agencies such as NRCS, cooperative extension, and state forestry services fell largely between the ages of 45 and 64. Only 35 % of respondents employed by the NRCS and 35 % employed by cooperative extension

were between the ages of 24 and 44. State forestry service foresters skewed younger, with 55 % of respondents falling between 24 and 44. The oldest group of respondents was registered foresters: 5 % were 24-34, while 68 % were 55 or older, and 21 % were 65 or older. Gender of respondents was also of note, as 85 % were males and 15 % were females. In terms of professional affiliation, respondents within the sample of NRCS and cooperative extension contained the highest proportion of female respondents (20 % and 19 %, respectively). For respondents within the sample of registered foresters, only 3 % of respondents were female.

For all groups of professional categories and states, the majority (64 %) of NRPs reported being "somewhat familiar" with silvopasture, with only 2 % reporting "not at all familiar" and 10 % reporting "somewhat unfamiliar" with the practice (Table 2). Alabama NRPs were most familiar with the practice, with 31 % stating that they were "very familiar," as compared to only 12 % of Mississippi NRPs (Table 2). Familiarity was significant by state ($p = .001$; test statistic = 16.609; DF = 3), with Alabama NRPs significantly more familiar than NRPs in both Mississippi ($p = .005$) and Georgia ($p = .002$). Furthermore, familiarity with silvopasture was significant by professional agency ($p = .004$; test statistic = 13.148; DF = 3) with NRCS significantly more familiar than cooperative extension NRPs ($p = .002$) (Table 3).

Table 2 Self-reported familiarity with silvopasture of natural resource professionals in four states, 2014 survey of NRPs in four Southeastern states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

		Not at all familiar		Somewhat unfamiliar		Neither unfamiliar nor familiar		Somewhat familiar		Very familiar		Total
State	AL	1	1 %	8	7 %	2	2 %	66	59 %	34	31 %	111
	FL	1	1 %	6	8 %	1	1 %	52	72 %	12	17 %	72
	GA	3	3 %	16	14 %	7	6 %	74	63 %	17	15 %	117
	MS	3	4 %	8	10 %	6	7 %	56	67 %	10	12 %	83
Total		8	2 %	38	10 %	16	4 %	248	65 %	73	19 %	383

Table 3 Self-reported familiarity with silvopasture of natural resource professionals in four professional categories, 2014 survey of NRPs in four Southeastern states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

Not at all familiar		Somewhat unfamiliar		Neither unfamiliar nor familiar		Somewhat familiar		Very familiar		Total N
N		N		N		N		N		
1	1%	8	6%	3	2%	80	64%	33	26%	125
4	3%	18	14%	7	6%	82	65%	16	13%	127
1	2%	5	9%	3	5%	39	67%	10	17%	58
2	3%	7	10%	3	4%	47	64%	14	19%	73
8	2%	38	10%	16	4%	248	65%	73	19%	383

When NRPs were asked where they learn about silvopasture, they reported a variety of sources, with "professional colleagues" (64 %) the highest reported source of information and "websites" the least (33 %) (Table 4). Respondents who included "other" filled in answers including "college courses, at work, experience, observation." Interestingly, 36 % of

respondents reported learning about silvopasture from landowners, illustrating that information flowed between landowners and NRPs in both directions. Additionally, it is worth noting that online information sources (used by 33 % of NRPs) did not replace information in print (used by 66 %). When NRPs listed websites they frequent, they cited www.silvopasture.org (an online silvopasture training session published as a partnership between the National Agroforestry Center, the NRCS, and the Unites States Forest Service) (Hamilton 2008).

Table 4. NRPs' self-reported sources of learning about silvopasture when asked, "Where do you learn about silvopasture?" from a 2014 survey of NRPs in four Southeastern states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

Information source	
Professional colleagues	64 %
Information or educational publications	61 %
Field days	60 %
Published scientific research	41 %
Landowners	36 %
Websites	33 %
Other	11 %

While 54 % of respondents affirmed their participation in a silvopasture-specific field day or training, significant differences between professional affiliations emerged ($p < .001$; Chi-square value 55.367) (Table 5). NRCS conservationists reported the highest level of participation in silvopasture field days or trainings (78 %), significantly more than all other groups ($p < .001$) while registered foresters reported the lowest (29 %) (Table 5), with cooperative extension training rates significantly higher than registered foresters ($p = .004$)

Table 5 2014 Reported participation in silvopasture-specific training or field days by professional category, survey of NRPs in four Southeastern of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

Agency	Yes	%	No	%	Total
Natural Resource Conservation Service	98	78 %	27	22 %	125
Cooperative Extension	68	54 %	59	46 %	127
State Forestry Service	22	37 %	37	63 %	59
Registered Foresters	21	29 %	52	71 %	73
Total	209	54 %	175	46 %	384

The highest rates of participation in silvopasture field days or other training events were in Alabama (67 %) and Mississippi (63 %) and the lowest was in Georgia (41 %) (Table 6) (Chi-square = 18.942; $p < .001$). Georgia NRPs reported significantly less training than Alabama NRPs ($p < .001$) and Mississippi NRPs ($p = .013$).

Table 6 Reported participation in silvopasture-specific training or field days by state, 2014 survey of NRPs in four Southeastern states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

State	Yes	%	No	%	Total
AL	74	67 %	37	33 %	111
FL	35	49 %	37	51 %	72
GA	48	41 %	70	59 %	118
MS	52	63 %	31	37 %	83
Total	209	54 %	175	46 %	384

While familiarity, learning, and training related to silvopasture have been important

factors influencing NRPs' engagement with landowners around silvopasture, these factors were largely irrelevant if NRPs did not perceive that silvopasture was relevant to their professional contexts. While no statistically significant differences emerged between either state (p = .457) or professional association (p = .387), NRPs who attended silvopasture training or a field day overwhelmingly believed that the training was professionally relevant for them (82 %).

Respondents overwhelmingly believed silvopasture to be "very" or "somewhat" appropriate for their physiography. Across states, 48 % of respondents indicated that they believed that silvopasture is "very appropriate (28 %) or "somewhat appropriate" for the physiographic region where they work (Table 7). Perceptions of appropriateness were significant by state (p=.02; test statistic = 14.632; DF = 3). Alabama NRPs perceived their soils, climate, and other biophysical characteristics to be significantly more appropriate for silvopasture than Mississippi NRPs (p = .001) (Table 7).

Table 7 NRPs' assessment of silvopasture's appropriateness for the physiographic region where they work, 2014 survey of NRPs in four Southeastern states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

State	Not at all appropriate		Somewhat inappropriate		Neither inappropriate nor appropriate		Somewhat appropriate		Very appropriate		Total	
AL	1	0 %	9	2 %	11	3 %	43	11 %	46	12 %	110	29 %
FL	1	0 %	5	1 %	6	2 %	42	11 %	17	5 %	71	19 %
GA	1	0 %	7	2 %	19	5 %	59	16 %	29	8 %	115	31 %
MS	2	1 %	7	2 %	20	5 %	38	10 %	14	4 %	81	21 %
Total	5	1 %	28	7 %	56	15 %	182	48 %	106	28 %	377	100 %

Alabama NRPs who indicated that silvopasture was somewhat or very appropriate for

their physiographic region commonly cited appropriate climate, forages, and soils. For example, NRPs referenced the species that work well in their area which are appropriate for silvopasture. One said, “Climate and soils allow for excellent forage production (with proper management) of both native and introduced grass species.” Another said, “Many different grasses grow well in my area and all pine species.” NRPs that referenced climate said, “Average rainfall is enough to support both trees and grass” and cited a “good growing season.” Those who referenced soils and topography supporting silvopasture acknowledge, “Large number acres of sandy and hilly land.” The climate, soils, and forage and tree species occur primarily in one region; many NRPs refered to, “primarily southern Alabama” or “lower coastal plain.” These climate and growing conditions and common pine and forage species coincide with established timber markets as well as land use history; he stated, “People have been grazing the forest here for centuries.” Alabama NRPs who rated their physiographic region as appropriate for silvopasture specified limitations for silvopasture related to soil quality; for example, “Timber does not grow very well on black belt soils.”

For Florida NRPs, the variety of physiographic regions in the state led NRPs to specify Flatwoods, which occur in North and South Florida, as appropriate for silvopasture. Similar to South Alabama NRPs, some Florida NRPs appealed to historical precedent, saying things such as, “Managing silvopasture mimics natural grass savannahs and flatwoods that are native to the area” and, “Several decades ago, woodland grazing was normal in this area.” North Florida NRPs also confirmed, “Our climate and soils are well-suited for silvopasture.” In other areas in Florida, NRPs said that silvopasture was inappropriate where land values are high or soil limits timber production, “properties have higher better uses;” “Soils are not suitable in SW Florida. South FL has [high] water tables and is not great for timber production.”

Georgia NRPs stated that appropriate areas "have good pastureland" and "highly erodible soils," where the addition of trees was seen as a benefit. Topographically, Georgia "Flat land" and land with "Some grade" was seen as appropriate for silvopasture. NRPs in this state concluded that regions where cattle and timber are productive they can be productively grown together. As one NRP said, "The county I work is one of the largest cattle counties in the state and has a large acreage of timberland." This productivity is a result of climate conditions. One NRP explained, "With our high rainfall here in the South, our lands can support multiple uses." NRPs pointed out southeast Georgia as appropriate and said, "Southeast Georgia is known for sandy soils, pine and forage production. [It has] Piedmont /clay soils, much forested land." Some considered the topography "too mountainous" topography led NRPs to rate silvopasture as "very inappropriate."

Mississippi NRPs saw silvopasture as appropriate in many regions across the state due to climate and native pine savanna ecosystems. NRPs cited, "Long growing season, hot temperatures [that] allow grassland savannas and forests to keep cattle cool while still providing forage." One NRP addressed suitable forage species: "We have suitable summer and winter forages that will tolerate some shade." As some Georgia NRPs, a Mississippi NRP perceived his region was "very appropriate" because it has the components of silvopasture commonly managed separately: "good soils, large tracts of land, large cattle population, large timber production." Areas where "agronomic crops dominate," such as the Mississippi Alluvial Valley, and where hardwood forests predominate were not viewed as appropriate for silvopasture. One NRP responded that, because the "soil productivity is high, the current best use of the land is row crop agriculture. However, silvopasture can and will work in the Delta." Also, based on comments by a few NRPs, silvopasture is perceived as less appropriate for central Mississippi, where longleaf

is not native.

Discussion

The NRCS was the professional category most familiar with silvopasture, which may have stemmed from their holistic mandate to assist private landowners in conserving natural resources and their status as a federal agency, which provides connections across states and counties. The significant difference in familiarity between NRCS and cooperative extension ($p = .002$) likely reflected the diversity of topics cooperative extension agents address, making them less familiar as a group with this specific land use. Given the appropriateness of substantial regions of all four states for silvopasture, a few targeted efforts (e.g. by the Center for Sub-Tropical Agroforestry [Workman et al. 2003]) and silvopasture support from respected NRPs in positions of institutional influence in Florida and Alabama (e.g. in state NRCS offices) have led to NRPs in these two states being significantly more familiar with silvopasture overall than NRPs in Georgia and Mississippi. This assertion was supported by NRPs indication that their most common source of information was professional colleagues (64 %).

By considering the states and professional associations NRPs come from and comparing these to silvopasture familiarity and training, we identified target groups for silvopasture education. The National Agroforestry Center and others with an interest in disseminating information about silvopasture may find these strategic recommendations helpful. We maintain that further education of NRCS agents, who are the most familiar with silvopasture, should focus on the states least familiar with silvopasture: Georgia and Mississippi. In both states, training should focus on cattle and timber producing regions, and in Mississippi, it should be build upon current familiarity and stress physiological appropriateness. Specifically, younger state forestry service foresters represent an opportunity to target silvopasture training for maximum landowner

impact. As a whole 37 % of state forestry service foresters had received training (and 91 % of those report it was professionally relevant), as compared with 78 % NRCS district conservationists (Table 5). This lack of training, combined with younger ages (state forestry service skewed youngest of all four groups, with 55 % of employees 24-44 years of age), represents an opportunity to target younger state forestry service NRPs. This is undergirded by the National Woodland Owner Survey's report that the landowners' top source of advice is state forestry agencies (Butler 2008). As shown in figure 7, 52 % of respondents employed by state forestry services have been asked about silvopasture by farmers or landowners, but only 37 % (figure 6) have participated in a field day or training related to silvopasture.

Disciplinary boundaries resulted in a siloed approach to technical information dissemination. Forestry, the art and science of managing timber, is quite separate ideologically and institutionally (e.g. within universities and government agencies) from conventional agriculture production, where forage management and animal sciences reside. Many landowners interested in silvopasture require technical assistance from animal scientists to manage the livestock and forage components and from foresters to manage the timber components. The top-ranked source of information about silvopasture was professional colleagues, which 64 % of NRPs identify as a source of information. Clearly, NRPs are communicating with each other about silvopasture, and this result indicated that some of the barriers between forestry and agriculture are being successfully crossed with regard to silvopasture. Additionally, areas with timber and cattle may be better able to support landowners practicing silvopasture because they have local NRPs well-versed in their management, especially if these NRPs are trained in silvopasture.

The multiple benefits to the involvement of NRPs in facilitating silvopasture adoption notwithstanding, the major critique of NRPs as agents of land use change on private land has been their potential to exert top-down control over landowners (Bridger and Alter 2006; Sakamoto and Hustedde 2008). Therefore, it is important for technical assistance and information transfer to be demand-driven and, if landowners do not request silvopasture assistance specifically, NRPs present it as one of a suite of economically and environmentally feasible options. Nationally, only 5% of the family forest owners, owning 10 % of the land in family forests, reported that their primary occupation is a farmer. Thus, 95 % or more of the family forest owners rely on off-farm income (Butler 2008). For landowners whose most important reasons for owning land are non-financial, land uses that achieve their highly-ranked objectives (e.g. beauty/scenery, to pass on to heirs, nature protection) that include financial returns may be particularly attractive.

Silvopasture training remains important for NRCS conservationists since we found this group has been asked by landowners about silvopasture more than any other (59 % report at least one landowner inquiry). Since the number of cooperative extension agents reporting of landowner inquiries (34 %) was incongruous with their participation in silvopasture field days or other training events (54 %), current levels of training for general populations of cooperative extension are likely sufficient for the number of landowners seeking assistance from this group. At this stage, strengthening referral networks within cooperative extension so that landowners who seek silvopasture assistance are efficiently directed to cooperative extension agents with silvopasture-specific training and experience will be valuable. Awareness among colleagues with disparate expertise areas is a form of social capital beyond silvopasture: As land use options change and expand, (including agroforestry practices), it becomes increasingly important for

generalists such as NRCS district conservationists and cooperative extension agents to be connected to professionals with specialist knowledge. Resources such as www.eXtension.edu, a national cooperative extension website which links visitors to NRPs focused on alternative land uses, offers one such opportunity.

We identified two priority NRP professional groups and two states where silvopasture-specific training can be targeted to have the greatest impact. First are foresters employed by state agencies and registered foresters with an interest in the topic of silvopasture. While 52 % of state forestry service NRPs reported being asked by landowners for assistance with establishing or managing silvopastures, only 37 % reported having ever participated in a silvopasture field day or other training event related to silvopasture. Secondly, while only 29 % of registered foresters indicated that they had participated in a silvopasture field day or other training event, 39 % reported that a landowner had asked them for assistance with establishing or managing all or part of their land in silvopasture. Developing continuing-education eligible training for registered foresters and publicizing the silvopasture.org online training module for these groups may increase familiarity among this group. Silvopasture familiarity was significantly higher in Alabama than Georgia ($p = .002$) and Mississippi ($p = .005$), indicating opportunities to target NRPs in these two states. Targeting cattle and timber producing regions in Mississippi may be particularly effective, given Mississippi NRPs' assessment that silvopasture was less appropriate than Alabama NRPs' believed for their physiographic regions, though they have several physiographically similar regions. It was curious that Mississippi NRPs' familiarity with silvopasture was similar to Georgia NRPs even though Mississippi NRPs reported receiving significantly more training than Georgia NRPs ($p = .013$). This may indicate that where silvopasture is not perceived as physiographically appropriate, training does not increase

familiarity.

One potential strategy to improve the technical assistance flowing to landowners through registered foresters will be to identify foresters with an interest in silvopasture within the population of registered foresters and to tailor silvopasture-specific information and training events to this group. Simultaneously, communicating a succinct message to the entire population of registered foresters describing what silvopasture is and who in the registered forester community has experience and training in it will improve referral networks. In short, landowners need to assemble a team of experts and ideally, NRPs will employ their professional networks to aid landowners in this process.

The physiographic diversity within states makes education about silvopasture more appropriate for specific physiographic regions (physiographic conditions and landowner conditions) rather than educating by state. This makes coordination between states as important as, if not more important than, coordination within states. However, coordination between states may be challenging, especially in state forestry divisions, cooperative extension services, and certainly registered foresters because individuals in these groups operate more within states than the NRCS (i.e. a federal agency). For these NRPs to coordinate effectively around silvopasture (and other alternative land use systems), organizations such as the National Agroforestry Center, the Southern Group of State Foresters, and Southern Regional Extension Forestry, and the Association of Consulting Foresters may play an important role.

It is an unusual NRP who is immediately comfortable with silvopasture, such as one who expressed, “I liked the idea of multiple uses of the land. You are growing timber, providing forage for livestock as well as wildlife food and cover.” More commonly, NRPs feel and express resistance to the premise of silvopasture (Zinkhan 1996). While biologically, timber, forage, and

livestock components are interrelated and positively interact to the increased efficiency of each component, the management goals and assessment criteria associated with each component's discipline (e.g. Forestry, wildlife, livestock) can be contradictory. Some NRPs echoed this view when they said, "I am more interested and involved with natural habitat and ecosystems establishment and maintenance. I feel like livestock foraging is detrimental to this plan." In this case, a restoration ecologist sees integrating livestock as contradictory to his or her professional identity and methods. This bias is not reflected in the perspectives of other NRPs who are also interested in ecological restoration. One NRP in the Coastal Plain region said, "I see the cows in the woods playing the ecological role that the bison and elk played before the Spanish arrived. They were here, but now they're gone, and surely they had a role in the system."

Disciplinary norms and methods of evaluation may constrain NRPs' evaluation of the suitability of silvopasture. One example of a timber perspective contradicting a silvopasture perspective is in the concept of "full site stocking." To a forester, a stand of timber is fully stocked when all available growing space (i.e. sunlight) is being utilized by trees and thus turned into tree diameter growth. A stand is under-stocked if sunlight is reaching the forest floor and thus not being photosynthesized by tree foliage (Nyland 2007). In a silvopasture system, canopy closure never occurs and the timber stand is always under-stocked, as a proportion of the available sunlight is always needed to facilitate the growth of the forage component in the understory. Consequently, a forester may view silvopasture as an inefficient system that underutilizes a site. From a silvopasture perspective, the site is fully stocked with timber and forage.

The differences in perspectives of NRPs from areas such as forestry, livestock and forage, economics, and wildlife should be addressed explicitly in training efforts. For example,

silvopasture trainers might show a photo of a silvopasture with mature trees and say, “Now I know the foresters in the room are noticing the light on the forest floor and seeing wasted photosynthetic potential that should be captured by trees. And wildlife biologists are seeing unnecessary competition between livestock and wildlife for food. Of course, you are both right, based on how you have been trained to assess productivity. Now, shift your perspective and put yourself in a landowner’s shoes. For landowners who wish to enjoy the beauty of their land while achieving long-term income from timber, and who enjoy managing cattle, in their eyes, this is a fully productive site. To a landowner with those objectives, this is much more productive than conventional forestry or pasture, because they are enjoying all the elements they desire, instead of one or two. Our perspectives are all important, but our task as natural resource professionals is to support landowners in pursuit of their objectives with our knowledge and experience of what is biologically possible. And for landowners with appropriate sites, silvopasture is biologically possible and productive.”

Reminiscent of Occam’s razor, the simplest explanation of the physiographic context where silvopasture is most appropriate is likely most accurate (Baker 2013). One NRP perceived his region to be very appropriate for silvopasture because it had, “Good soils, large tracts of land, large cattle population, large timber production.” One principle that emerged from our data was that the regions where timber and cattle were currently produced separately were also where NRPs believe they will be most successfully produced together in silvopasture systems. However, NRP comments indicated that this position was not universally held. The history of promotion of silvopasture as a practice appropriate for small holdings of marginal lands by limited resource farmers, has, as one NRP put it, “put silvopasture in a box.” A Georgia NRP who does not see silvopasture as appropriate for the landowner he works with because it

"conflicts with both pasture and forestry objectives" typified this perspective. He continued, "[Silvopasture is] generally only applicable to someone that is resource limited and/or hobby farming." His sentiments reflect how the practice has been sometimes framed and communicated, but the statements are contradictory: It's either for the very poor or the very rich, neither of whom will make money on the timber component or the livestock component.

Another illustration about misconceptions of silvopasture was that it is timber species-specific. For example, one NRP perceived that his region was inappropriate for silvopasture because it was not native longleaf range. This was likely a misunderstanding of a silvopasture training or publication; in an effort to communicate that longleaf pine is an appropriate species for Southeastern silvopasture, the message was misconstrued by one NRP that silvopasture requires longleaf pine. Comments such as this demonstrate that when conducting training, it is important for trainers to communicate the practices and species that silvopasture may include, but also make clear that there is a wide range of context- and objective-specific arrangements that may all be accurately termed silvopasture. Training, field days, and demonstrations must convey that silvopasture is the intentional management of three components: timber, forage, and livestock; it is compatible with other land management practices, such as rotational grazing, native forages, pine straw harvesting, and longleaf pine restoration. However, these practices do not make a silvopasture.

Conclusion

Results from this study build upon previous temperate agroforestry adoption studies by elucidating the current state of silvopasture knowledge and applicability of an important user group: the professionals who advise landowners. Familiarity on the part of NRPs has increased since Workman et al. (2003) found that NRPs reported "lack of familiarity with the practices"

and “lack of demonstrations” as “very important” obstacles to the practice of agroforestry. We found that 64 % of NRPs reported being “somewhat familiar” with silvopasture and an additional 19 % were “very familiar” (Table 2). Across four states, NRCS agents participated in significantly more training than state forestry service NRPs and registered foresters. In particular, NRPs in state forestry services represent an opportunity for targeting training: 52 % indicated that a landowner had asked them about silvopasture, but only 37 % had participated in training. Since the state forestry employees who responded to this survey tended to be younger than the other categories, we extrapolate that training will position them to pass on their learning for their many remaining years of advising landowners.

Perception of suitability of a region for silvopasture hinged on the presence of active cattle and timber management in an area, as well as climate, productive forages, and soils. The regions where landowners historically practiced livestock grazing of forest range were identified by NRPs as appropriate for the practice of silvopasture (e.g. pine Flatwoods in Florida and south Alabama).

Our analysis shows that opportunities for future work include revisiting silvopasture training materials. For example, including examples of different silvopasture systems in settings that are similar across regions will address the misconception that silvopasture has a prescribed formula (e.g. species, arrangement, etc.) This may involve an update to the silvopasture.org training module and informational publications. Additionally, we propose making comparisons of silvopasture training, learning, and perceptions of appropriateness in the southeastern U.S. with other temperate physiographic regions.

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Chapter 4

Title: Natural Resource Professionals' engagement with landowners on silvopasture in the Southeastern U.S.

Abstract

Landowners manage for multiple objectives (e.g. timber production, wildlife habitat, as a legacy for heirs) and natural resource professionals (NRPs) are tasked with supporting them with guidance and technical assistance. Across the southeastern United States more landowners are considering silvopasture in pursuit of their land management objectives. Silvopasture is a multi-use system incorporating timber, forage, and livestock on the same land unit. However, NRPs may be of limited assistance if they are unfamiliar with what the practice entails. To understand their perceptions about and knowledge of silvopasture systems, we surveyed NRPs in four professional categories (Natural Resource Conservation Service, Forestry Service/Commission, Cooperative Extension Service, and registered foresters) within four Southeastern U.S. states (Alabama, Georgia, Florida, Mississippi). Across states, about half of NRPs (48 %) indicated that they believed silvopasture was "somewhat appropriate" or "very appropriate" for the landowners they worked with and their physiographic region.

Keywords: agroforestry adoption, extension, NTFP, woodland owners, land use change

Introduction

The land management objectives of forest landowners are changing, and it follows that the professionals who advise them must refashion the support they provide to help them meet

their goals. In a national survey, private landowners in the U.S. reported that the top reasons they owned forestland were for aesthetic value, to pass on to heirs, as part of a family farm, for recreation, and for timber production (Butler 2008). One agroforestry practice, silvopasture, combines timber and livestock and is especially well-suited to the forest management practices of the southeastern region of the U.S. (Ares et al. 2003; Brauer et al. 2009). Silvopasture is a complex, dynamic, and intensive management system of timber, forage, and livestock for multiple forest products and ecological benefits on a single site. The nuanced management of multiple species (timber, forage, and livestock) for mutually beneficial interactions between species distinguishes a silvopasture (Gold and Hanover 1987). With multiple objectives and species under management, landowners interested in adopting silvopasture may find it necessary to collaborate with natural resource professionals (NRPs) with a variety of skill sets and expertise, including forestry, livestock, forage production, silvopasture, or agricultural economics and farm business management. However, landowners and the professionals who advise them may be unaware or unsure of the opportunities provided by agroforestry systems such as silvopasture.

Natural resource professionals (NRPs) advise landowners on appropriate land uses, may provide technical support for land management, and may be employed by governmental agencies (e.g. Natural Resource Conservation Service [NRCS], cooperative extension, state forestry services or commissions), or be privately contracted (e.g. registered foresters who consult with private forest landowners). Because this includes an array of land management professionals, NRPs may have very different skill sets and academic training, and therefore diverse perceptions about various land management practices. Since the top sources of advice for U.S. forest landowners are, in order of importance, state forestry agencies, private consultants, and federal

agencies (Butler 2008), it is important that they are well-versed in multiple land uses and the ways each may meet a landowner's given objectives and site. However, these professionals may not be well versed in agroforestry practices and so may be of limited assistance to landowners requesting information about silvopasture.

In recent decades, agroforestry adoption literature has focused on two populations: landowners who are adopters or potential adopters of agroforestry systems and the NRPs who inform landowners' land management decision-making (Lawrence et al. 1992; Lawrence and Hardesty 1992; Pattanayak et al. 2003; Workman et al. 2003). These studies have shown that financial considerations were most important to NRPs who serve landowners, but that environmental concerns (e.g. wildlife habitat, soil health) mitigate financial factors for landowners who desire to enhance the intrinsic value of their land and leave a legacy for future generations through their stewardship. This discrepancy with its numerous implications for agroforestry, is cause to question how NRPs and landowners prioritize economic benefits and environmental benefits, and how NRPs engage with landowners around the topic of silvopasture.

The objectives of our current study were to 1) investigate the information exchange between landowners and NRPs about silvopasture, and 2) gauge NRPs' perceptions about the suitability, benefits, and obstacles to the implementation of silvopasture for the landowners they work with. We were particularly interested in differences between professional classifications of NRPs (e.g. state forest services, NRCS conservationists, cooperative extension, and registered foresters) and differences between NRPs in four contiguous Southeastern states: Alabama, Georgia, Florida, and Mississippi.

Methods

Drawing from themes that emerged from a literature review on agroforestry silvopasture as well as qualitative interviews with NRPs and landowners managing silvopastures, we designed a survey targeted to NRPs about their engagement with landowners about silvopasture.

The questionnaire was designed to take about 15 minutes to complete, and included multiple choice and open-ended follow-up questions designed to capture NRPs' attitudes toward silvopasture (e.g. financially, economically, environmentally, socially), and especially the degree that they perceived that silvopasture was a topic relevant to their work with landowners. We asked NRPs to evaluate the importance of reasons to practice or obstacles to landowners of having silvopasture on all or part of their land on a five-point Likert scale, with 1 representing "very important" and 5 representing "very unimportant;" and their level of agreement with statements with 1 representing "strongly disagree" and 5 representing "strongly agree." The questionnaire was deployed in November 2014 to our sample of NRPs.

We developed a sample of 1,038 NRPs in four states in the Southeastern U.S.: Alabama, Florida, Georgia, and Mississippi by retrieving NRPs' professional contact information (i.e. physical and email addresses) from publically accessible websites. In a few cases, organizations shared contact information with us. Our sample consisted of the following professional categorizations: cooperative extension agents, registered foresters, consulting foresters, state forestry services, and NRCS conservationists (detailed in Appendix 2). Alabama, Florida, Georgia, and Mississippi were selected because they are contiguous to Alabama (the location of the researchers), have similar forestry practices and industries, and are states where much forestland is under private ownership (Butler 2008). We used probability methods (Dillman et al. 2009) to sample 80 % of our sampling frame in order to achieve the desired 95 % confidence

level. We designed our sample to substantiate state and NRP category analysis by combining all categories of professionals within states and as well as all respondents in the same category of professionals.

Following Dillman's Tailored Design Method for web-based surveys (2009) we sent an initial pre-notice letter (Appendix 3), emails containing a web link to the Qualitrics-based survey (Appendix 1), a follow up post card (Appendix 5), and a second email. Results were exported from Qualtrics to SPSS (2013). Within SPSS, results were summarized and analyzed using descriptive statistics, cross-tabulations, and Chi-Square with dichotomous dependent variables and categorical independent variables. To compare differences between categorical groups (state and NRP categories), and ordinal dependent variables, we used a Kurskal-Wallis H; for differences between dichotomous groups (NRPs who rated themselves as "somewhat familiar with silvopasture" and "very familiar," and those who did not) and ordinal dependent variables, we used a Mann-Whitney U test. The .05 significance level was used. We included follow-up, open-ended questions to elicit explanations, which we quoted in our results.

Results

Of the 1,006 valid recipients, 452 questionnaires were returned, yielding a 45 % response rate. Three-hundred ninety (390) respondents answered "yes" to the question, "Are you an agricultural or land management professional who gives advice to private landowners or farmers about their management practices and are over the age of 19?" One respondent actively opted out after beginning the survey, yielding 389 valid, useable responses. The number of respondents allowed for comparisons between states and professional affiliation (Table 1).

Table 1 Number of respondents by professional category and state, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

	AL	FL	GA	MS	Total
Natural Resources Conservation Service	33	28	24	42	127
Cooperative extension	47	12	50	19	128
State forestry services	7	25	15	13	60
Registered foresters	24	9	31	10	74
Total	111	74	120	84	389

First, we were interested in how many landowner inquiries about silvopasture NRPs had received. Overall, 175 respondents (46 %) answered “yes” to the question, “Has a farmer or landowner ever asked you for assistance with establishing or managing all or part of their land in a silvopasture?” (Table 2). Florida and Mississippi responses differed significantly from those by NPRs in Alabama and Georgia ($p = .051$). NRPs in Mississippi reported the lowest incidence of landowners asking about silvopasture (34 %), and Florida NRPs reported the highest (56 %) (Table 2).

Table 2 Number and percent of NRPs reporting that one or more farmers or landowners have asked them for assistance (yes or no) with establishing or managing land in silvopasture by state, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

State	Yes		No		
AL	50	45 %	60	55 %	110
FL	40	56 %	32	44 %	72
GA	57	49 %	59	51 %	116
MS	28	34 %	54	66 %	82
Total	175	46 %	205	54 %	380

Forest land owners inquired about silvopasture from their top three most trusted sources of advice (Butler 2008): foresters in state agencies, consulting foresters, and federal agencies (NRCS) (52 %, 39 %, and 59 %, respectively, receiving inquiries) (Table 3). NRCS conservationists were significantly more likely to have been asked about silvopasture (59 %) than cooperative extension agents (34 %) or registered foresters (39 %) ($p = .001$). NRCS agents are most likely to have been asked by a landowner about silvopasture (59 %) and registered foresters (39 %) least likely (Table 3). However, Georgia and Florida state foresters (63 % and 67 %) reported being asked about silvopasture more than Alabama or Mississippi state foresters (29 % and 25 %) (Table 3).

Table 3 Number and percent of respondents who have been asked by a landowner about silvopasture for 13 professional categories, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

Agency	Yes	%	No	%	Total
Alabama Natural Resource Conservation Service	23	70 %	10	30 %	33
Florida Natural Resource Conservation Service	16	59 %	11	41 %	27
Georgia Natural Resource Conservation Service	17	71 %	7	29 %	24
Mississippi Natural Resource Conservation Service	18	44 %	23	56 %	41
Total state Natural Resource Conversation Service	74	59 %	51	41 %	125
Alabama cooperative extension	15	33 %	31	67 %	46
Florida cooperative extension	4	33 %	8	67 %	12
Georgia cooperative extension	19	40 %	29	60 %	48
Mississippi cooperative extension	5	26 %	14	74 %	19
Total cooperative extension	43	34	82	66 %	125
Alabama state forestry service	2	29 %	5	71 %	7
Florida state forestry service	15	63 %	9	38 %	24
Georgia state forestry service	10	67 %	5	33 %	15
Mississippi state forestry service	3	25 %	9	75 %	12
Total state forestry service	30	52 %	28	48 %	58
Alabama registered foresters					20
Georgia registered foresters					35
Florida registered foresters					8
Mississippi registered foresters					10
All registered foresters	28	39 %	44	61 %	73
Total	175	46 %	205	54 %	380

The respondents who reported that landowners had inquired about silvopasture were asked to estimate how many, and their answers ranged from 1-200 (mean = 6.6; SD = 16.321). They estimated the landowners they have worked with to be “somewhat unfamiliar” (median 2)

with the practice of silvopasture; this was not significant by NRP group ($p = .323$) or state ($p = .263$).

After receiving an inquiry about silvopasture from a landowner about silvopasture, NRPs subsequently took a variety of actions to provide information and assistance. Most commonly, NRPs visited the landowner's site (80 %), provided technical assistance (74 %), and provided print information (58 %) (Table 4).

Table 4 Type of assistance provided to landowners who inquired about silvopasture, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

Assistance provided to landowners	
Visited site	80 %
Provided technical assistance	74 %
Provided print information	58 %
Assisted with development of a land management plan	51 %
Referred to NRCS	43 %
Referred to cooperative extension	33 %
Referred to other	15 %

Despite this uniform assessment of lack of familiarity, we noted a great variety in NRPs' perceptions of silvopasture as appropriate for the landowners they work with (Table 5). Approximately half of NRPs saw silvopasture as "somewhat appropriate" or "very appropriate" (52 %) for the landowners and farmers where they work (Table 5). Alabama NRPs believed silvopasture to be significantly more appropriate for their local landowners than Georgia NRPs ($U = 5364$; $z = -2.114$; $p = .034$)

Table 5 Reported NRP perception of silvopasture as appropriate for their average farmer or landowner by state, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

State	Not at all appropriate		Somewhat inappropriate		Neither inappropriate nor appropriate		Somewhat appropriate		Very appropriate		Total
AL	2	2 %	18	16 %	30	27 %	54	49 %	7	6 %	111
FL	3	4 %	8	11 %	18	25 %	39	54 %	4	6 %	72
GA	6	5 %	20	17 %	29	25 %	58	50 %	3	3 %	116
MS	6	7 %	15	18 %	28	34 %	27	33 %	6	7 %	82
Total	17	4 %	61	16 %	105	28 %	178	47 %	20	5 %	381

Across states, respondents indicated that although silvopasture might be appropriate for the physiographic region in which they work, they felt that it was less appropriate for the average farmer and landowner in that same physiographic region. For example, respondents explained that while the climate and forage growth would support silvopasture, landholdings were too small for silvopasture. One Florida NRP said, “Our climate and soils are well-suited for silvopasture. However, I think most local landowners like trees because they can be established relatively cheaply and they require little care.” Florida NRPs who saw silvopasture in practice believed silvopasture was appropriate for their landowners. One remarked, “It's being done locally and the word of mouth is very common in the community.” Similar to Alabama NRPs, Florida NRPs perceived silvopasture to be inappropriate for landowners in their region related to the cultural practices or “mindset” of cattle producers and timber producers related to management intensity and timeframe. Timber producers were uninterested in the management intensity that livestock require and cattle producers perceiving the years trees require to become established as a barrier. They expressed ideas such as, “I call forestry ‘low-maintenance

agriculture,'" and with regard to cattle producers, "I'm not sure we could get the ranchers to pull the land out of production long enough for the trees to go up a bit."

Overall, about half (48 %) of NRPs surveyed reported that silvopasture was "somewhat appropriate" or "very appropriate" for the landowners with whom they work (Table 5) and "somewhat appropriate" or "very appropriate" for the physiographic regions they serviced (Table 6). Notably, NRPs in Mississippi were significantly less likely to report that silvopasture was "somewhat" or "very appropriate" for landowners in their state (39 %) when compared to their colleagues in Alabama (55 %), Florida (51 %), and Georgia (51 %) (Pearson Chi-square value = 6.803; p = .078). Perception of silvopasture appropriateness for NRPs' physiographic regions was significant by state (p = .002; test statistic = 13.6, DF = 3) (Table 6).

Table 6 Reported NRP assessment of silvopasture appropriateness for the physiographic region (e.g. climate, soils, vegetation) where they work, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

State	Not at all appropriate		Somewhat inappropriate		Neither inappropriate nor appropriate		Somewhat appropriate		Very appropriate		Total	
AL	1	0 %	9	2 %	11	3 %	43	11 %	46	12 %	110	29 %
FL	1	0 %	5	1 %	6	2 %	42	11 %	17	5 %	71	19 %
GA	1	0 %	7	2 %	19	5 %	59	16 %	29	8 %	115	31 %
MS	2	1 %	7	2 %	20	5 %	38	10 %	14	4 %	81	21 %
Total	5	1 %	28	7 %	56	15 %	182	48 %	106	28 %	377	100%

Significantly more NRPs in Alabama believed silvopasture was appropriate for their physiographic regions than Mississippi NRPs (p = .001). In Alabama, regions where landowners commonly manage trees and cattle on separate tracts were regions that NRPs perceived as appropriate for the adoption of silvopasture; they made statements such as, "Many cattlemen in

the state are also in the forestry business. [Silvopasture] would be particularly applicable for southern Alabama." This was opposed to regions of Alabama where NRPs rate silvopasture as inappropriate in terms of landowners' cultural conceptions of land management intensity and timeframe. Where landowners have practiced low-intensity, "tree farming only," Alabama NRPs said, "I think it could be very good for some, but here again I don't know that many would have 'want to' to follow through with the practices." The difference in timeframe between timber and livestock production was perceived as a barrier to both timber producers accustomed to low-intensity, long-term return intervals and high-intensity, short-term cattle producers. NRPs where landowners have typically managed only cattle expressed, "Most cattle farmers think of maximizing grass potential without thought of timber opportunities or planning that far ahead in the case of starting with bare land." Also, several cited the economic and production trade-offs of the integrated system and current markets: "Timber prices are too low and forage productivity is too low." NRPs who work primarily in areas where landowners have smallholdings cited limited acres as their reason for rating silvopasture as inappropriate.

The Mississippi NRPs who stated that silvopasture was inappropriate for the landowners they worked with focused on current land use. For example, "The Delta area of the state is commercial ag[ronomic] crop production [with] very few acres of forestry or livestock production". In southern Mississippi, an NRP stated, "Many acres of pine plantation with the opportunity to graze cattle in the heavy fescue understory if it's not tied up in a CRP contract" could make silvopasture appropriate for their landowners. Some Georgia NRPs perceived that landowners desired to add revenue streams and intensify, specifically with regard to expanding pasture into forests, and thus that rate silvopasture as appropriate for landowners they have worked with. One said, "Cattlemen are looking at ways to utilize land underneath thinned pines."

Those who saw silvopasture as inappropriate for the landowners in their region saw it in conflict with wildlife objectives their landowners held. “Most hunt on their timber tracts or lease for hunting. [Silvopasture] reduces cover and browse.” Differences in perceptions of physiographic appropriateness for silvopasture were not significant by NRP category ($p = .706$) (Table 6).

NRPs familiar with silvopasture and their perceived reasons to recommend silvopasture/enabling factors for landowners

As we were interested in the factors NRPs believed either enable or constrain landowners’ success with silvopasture, we analyzed NRPs perceptions of social, economic, and environmental factors related to silvopasture (Tables 7 and 8). The questions were rated on a 5-point Likert scale where one equals “strongly disagree” and 5 equals “strongly agree.”
The Mann-Whitney U results indicated items where NRPs who are familiar with silvopasture were statistically significantly different than those who were unfamiliar. The Kurskal-Wallis H column revealed statistically significant differences by professional category; no results were statistically significant by state. The greatest number of statistically significant answers to questions between any two groups were cooperative extension and state forestry services (with seven); NRCS and state forestry (with six); NRCS and registered foresters (five); and registered foresters and cooperative extension (with four) (Table 7). State forestry services differed significantly from other groups most often, a total of 15 times, with registered foresters differing significantly from other groups only six times.

Table 7 Statistically significant results of NRP agreement with statements related to reasons to practice silvopasture, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

	Mann-Whitney U			Kurskal-Wallis H (by professional category)			
	Median	p-value		p-value		Significant pairwise comparisons	Test statistic
Enhancing ecological sustainability through diversified agricultural production systems is an important goal	4			0.007			
Improving the economic and ecological balance of agricultural systems is an important goal	4	0.001	***	0.012	*	4:1 (p =.099)	10.904
Silvopasture can increase soil moisture through the inclusion of trees	3	0.021	*	0.429			
Livestock need shade during the heat of the day	4	0.106		0.016	*	4:2 (p.029)	10.283
Silvopasture can increase daylight grazing during hot summer months	4	0.018	*	0.301			
Soil compaction is an important concern in silvopasture management	4	0.493		0.001	***	1:4 (p<.001); 1:3 (p<.001); 2:4 (p=.022) 2:3 (p<.001)	17.291
Soil moisture is a major limiting factor in cool season forage production	4	0.012	*	0.001	***	2:3 (p=.026); 3:1 (p=.016); (4:2 p=.026); 4:1 (p=.015)	17.291
Increasing the number of forested acres is an important goal	3	0.013	*	0.001	***	1:3 (p<.001); 2:3 (p<.001)	23.861
Restoring the native forest land of my region is an important goal	3	0.002	**	0.01	**	4:3 (p=.013); 2:3 (p=.023)	11.395
Enhancing wildlife habitat on agricultural lands is an important goal	4	0.168		0.042	*	4:1 (p=.029)	8.22
Silvopasture systems can help reduce financial risk for producers by diversifying income streams	4	0.001	***	0.167			
Silvopasture systems produce higher profit margins than forage livestock production alone	3	0.001	***	0.914			
Diversifying agricultural systems is important from a financial standpoint	4	0.001	***	0.087			
It is important to have an economically diversified farm or land base	4	0.001	***	0.063			
Livestock producers are generally opposed to adopting intensively managed livestock systems	3	0.921		0.001	***	3:2 (p=.017); 3:1 (p<.001); 4:2 (p=.021); 4:1 (p<.001)	24.846
Land management innovations are generally viewed with skepticism by the landowners I work with	3	0.347		0.003	**	3:2 (p=.017); 3:1 (p=.002)	14.221
The land owners I work with are looking for new options for land management	3	0.001	***	0.744			
Many private landowners are interested in enhancing wildlife habitat while receiving income from a complimentary land use	4	0.054		0.009	**	1:3 (p=.005); 2:3 (p=.034)	11.609

* denotes p<.05; ** denotes p<.01; *** denotes p<.001

NRPs' assessment of obstacles for landowners to practice silvopasture

NRPs took a number of factors into account when deciding which land use to recommend to a landowner, including their perceptions of the obstacles a landowner was likely to face while pursuing a land use. Of the 12 obstacle factors listed, NRPs rated ten factors as "somewhat important" (median 2) and two as "neither important nor unimportant" (median 3). Taken together, NRPs rated all barriers with a high level of importance (Table 8). As above, the Mann-Whitney U test identified statistically significant differences between familiar and unfamiliar NRPs. NRPs familiar with silvopasture rated the landowner barriers of "lack [of] technical assistance" and "lack demonstration" as significantly less important than unfamiliar NRPs, presumably because they lack awareness of technical assistance and demonstrations available. Similarly, cooperative extension NRPs rated the landowner barrier "lack [of] financial incentive" as more important than NRCS NRPs did, probably because NRCS NRPs were closely involved with facilitating access to funding that is applicable to silvopasture and the cooperative extension group was not, and thus was less aware that financial resources are available for silvopasture.

Table 8 NRP evaluations of importance of obstacles to landowners practicing silvopasture, 2014 survey of natural resource professionals Number of respondents by professional category and state, 2014 survey of natural resource professionals in four Southeastern U.S. states of Alabama (AL), Florida (FL), Georgia (GA), and Mississippi (MS)

	Mann-Whitney U			Kurskal-Wallis H			
	Median	p-value		p-value		Significant pairwise comparisons (between professional groups)	Test statistic
Livestock damaged trees	2	0.409		0.823			
Component competition	2	0.979		0.404			
Lack information	2	0.17		0.185			
Lack markets	3	0.408		0.783			
Expensive management	2	0.536		0.177			
Lack familiarity	2	0.88		0.431			
Lack technical assistance	2	0.004	**	0.145			
Lack demonstration	2	0.019	*	0.336			
Lack financial incentive	2	0.925		0.009	**	2:1 (p=.011)	11.581
Eliminates options of other land uses	3	0.161		0.05	*		7.832
Length of wait time from planting trees in existing pasture till trees can be harvested	2	0.976		0.192			
Length of wait time from planting trees in existing pasture till livestock may be permitted to graze	2	0.544		0.019	*	1:4 (p=.045)	10.005

* denotes p<.05; ** denotes p<.01

Discussion

Across categories, 46 % of NRPs have had landowners inquire about silvopasture and evaluated the landowners they work with as generally “somewhat unfamiliar” with silvopasture.

This represents a noteworthy growth in landowner interest and familiarity with silvopasture since Workman et al. (2003) reported landowner and NRP awareness of agroforestry as "quite low," and Zinkhan and Mercer's (1996) assessment, when approximately half of NRPs had any professional experience with any agroforestry system. With the lowest reported landowner inquiries, Mississippi offers an opportunity for targeted landowner education on silvopasture, especially through the NRCS and Mississippi Forestry Commission channels (44 % and 25 % reported inquiries, respectively).

NRCS conservationists likely reported receiving significantly more inquiries about silvopasture than cooperative extension and registered foresters as a result of the network of training and demonstration sites they initiated (Workman et al. 2003). Additionally, cooperative extension has a very broad scope of work and registered foresters have a more specific one. NRCS, as a federal agency, is regarded as a source of information, technical assistance, and financial incentive for all land-based conservation practices, and is a natural first stop for landowners interested in forestry. The actions NRPs took after a landowner inquired were expected. Though only 43 % referred landowners to the NRCS, this is likely skewed by the number of respondents from the NRCS. In other words. Educating all NRPs about cost-share programs available will likely increase referrals to the NRCS. Considering that 58 % shared printed information, NAC and NRCS should consider sending printed information to all categories of NRPs, especially registered foresters and state forestry service foresters.

In short, culture is more limiting than land. NRPs in all four states perceived that the management desire and capacity of landowners was more limiting than the physiographic characteristics of the land, specifically with regard to landowners' ability and interest in intensive management. Absentee landownership emerged as a specific constraint to silvopasture and other

intensifications. While Mississippi and Alabama are similar in climate, soils, forage productivity, and other aspects of physiography, Alabama landowners perceived silvopasture to be appropriate for their region while Mississippi NRPs did not ($p = .001$). This discrepancy offers a potential focus for silvopasture training in Mississippi: soil, timber species, water, and other land-based requirements for silvopasture.

Several NRPs ventured that the learning and adjustment required for cattle producers who wish to graze forests is likely much quicker than timber-experienced landowners who wish to learn about cattle. This reiterates the simple explanation that land that is suited for timber and cattle production will be well-suited for silvopasture systems. Landowners who currently manage cattle and timber separately should be targeted for silvopasture education because they will likely be most amenable to and successful with managing them together. Of special note, landowners who currently have stands of timber in expiring CRP contracts and cattle are in a prime position to transition their former CRP acres to understory forage and extend their cattle range into their forested acres utilizing EQIP financial assistance and other NRCS financial incentives. Intensity of management is influenced by both the physiographical capacity of the land and local culture, which reinforces that land use change must account for place and people (Bridger and Alter 2006). Further, when NRPs described why they perceived silvopasture to be appropriate to their landowners, the results underscored the principle that land use recommendations must be tailored to the objectives, resources, and constraints of individual landowners.

With regard to appropriateness of silvopasture for landowners, NRPs across states expressed common themes: that appropriateness of silvopasture is landowner-specific, silvopasture requires trade-offs for both timber and livestock production, assessments of profitability, and landowners' cultural attitudes toward the separation of cattle and timber. Many

NRPs recognized that silvopasture "is very landowner specific, not for the average producer. It depends on the objectives of the producer." Where livestock and cattle are not typically mixed and traditional plantation forestry is the norm, especially when forested land is under CRP rental contracts, NRPs often believe, "To do one or the other is most profitable." Where the cultural attitude favors separation of cattle and timber, NRPs were more likely to say, "Landowners are either strictly focused on cattle or timber not a combination of both." However, in areas where forestland grazing has been practiced historically, there is an acceptance of the combination of cattle and timber, and NRPs expressed, "Cattle/livestock is big business in FL. Grazing on private and state forests where this is appropriate and if the site conditions allow for a combination of the two, make good financial and environmental sense."

NRPs' perceived reasons to recommend silvopasture/enabling factors for landowners

Some of these findings likely stemmed from the goals, environmental ethics and values of their professional affiliation, such as, "Increasing the number of forested acres is an important goal" and "Restoring the native forestland of my region is an important goal" (Table 7). Other findings were perhaps a result of higher levels of silvopasture training and familiarity with silvopasture, such as the observation that, "Some cool season grasses may increase production under reduced light intensities in silvopasture" (Table 7). Here, we see the effects of sources of information about silvopasture. These were likely observations NRPs made, gleaned from landowners, or learned through silvopasture-specific training and published material.

There was little consistency with regard to the results of pairwise comparisons between professional categories. State forestry service NRPs differed significantly from other groups most often (15 times, as opposed to NRCS and cooperative extension, each with 11 and registered foresters, with 6), demonstrating some important considerations. The topics on which

they differ centered on some silvopasture-specific assessments (e.g. soil compaction is an important concern with silvopasture), financial considerations (e.g. "cost of physical infrastructure is a major barrier"), and objectives of landowners, (e.g. "land management innovations are viewed with skepticism by landowners I work with" and "many private landowners are interested in enhancing wildlife habitat while receiving a complementary income." Some of these differences might signify characteristics of the types of landowners state forestry service NRPs typically work with, but several are opportunities to target information about silvopasture. Given other results related to state forestry service NRPs, especially those in Alabama and Mississippi (e.g. familiarity, participation in training, landowners inquiring about silvopasture), this group is a prime target for silvopasture training. Ideally, training should be done in conjunction with local NRCS, who may educate on financial incentives and provide information. Strengthening ties between state forestry service and local NRCS may facilitate landowners' access to cost-share programs and other forms of technical assistance.

Other differences between NRP groups are likely the result of the different populations of landowners each professional affiliation works with. Some significant differences (e.g. "lack [of] financial incentive) illustrate that landowners NRCS and cooperative extension work with may be more constrained financially, and thus seeking government-subsidized options, in contrast to the population of landowners who use consulting foresters. National Woodland Owner Survey results demonstrated that landowners who own larger numbers of acres were found to employ the services of consulting foresters more than those who own smaller numbers of acres (Butler 2008). Landowners who employ the services of consulting foresters were likely perceived by NRPs as more innovative than those who seek assistance from NRCS conservationists since they have more acres and forest-related income with which to experiment. Thus, the degree to which

they responded, “Land management innovations are generally viewed with skepticism by landowners I work with” varied significantly between professional affiliations. Similarly, landowners seeking assistance from the NRCS may lack financial resources to employ silvopasture. This combination of lack of innovativeness and financial resources is supported by data collected during qualitative interviews. NRCS conservationists described the landowners they work with who contact the NRCS in search of cost-share programs, not necessarily with innovative practices in mind: “Most cattle managers, they see the USDA (United States Department of Agriculture) as providing money to help them do things, that’s their thought process,” and, “They want to know, ‘How much money is there to help me do that?’ They’re looking for an advantage, but we use that as a springboard to address resource concerns on the farm.” Conversely, registered foresters expressed in qualitative interviews that landowners introduced them to the concept of silvopasture and reached out for their professional assistance with the particular practice in mind.

NRPs’ assessment of constraining variables for silvopasture

The totality of the barriers to landowners should not be understated: NRPs rated all obstacles we listed with a median of two or three, indicating “somewhat important” (10 obstacles) or “neither unimportant nor important” (2), has underscored that barriers likely preclude silvopasture from becoming a widespread practice. Nevertheless, NRPs familiar with silvopasture saw it as strong option for atypical landowners with characteristics that allow them to overcome these multiple challenges.

Perceptions that landowners “Lack financial incentive” was a barrier to landowners interested in silvopasture was significantly higher for cooperative extension than for registered foresters, likely reflecting landowners who contact cooperative extension for no-cost assistance

have greater financial constraints to land management than landowners who hire registered foresters (Table 8). Silvopasture-specific training for registered foresters should be pursued, given that resource-endowed landowners may be in a position to overcome barriers to silvopasture adoption, and that 39 % of registered foresters reported landowners inquiring about silvopasture. Training should be conducive to meeting the Georgia, Alabama, and Mississippi continuing education requirements for foresters registered in each state, especially training approved by the Society of American Foresters and the Association of Consulting Foresters.

Conclusion

Results build upon previous temperate agroforestry adoption literature by elucidating the current state of silvopasture engagement between landowners and NRPs. In short, the word has gotten out about silvopasture, as evidenced by the number of NRPs who reported that landowners have asked about the practice (46 %) and the number of landowners having asked about silvopasture (a mean of 6.6 landowners per NRP who reported having been asked). The considerations NRPs made when deciding whether to recommend silvopasture to landowners or not related to profitability, acceptability of trade-offs of livestock and timber production, and cultural attitudes toward combination of cattle and timber. However, all the obstacles NRPs perceive for landowners to implement and practice silvopasture successfully were high, rated as "very important" to midway between "somewhat important" "neither unimportant nor important." In sum, NRPs see substantial reasons to not recommend the practice of silvopasture to many landowners. However, for landowners who have land in both livestock pasture and timber, and sufficient financial resource and social capital to access the technical assistance they need, NRPs saw silvopasture as an effective way to extend either the tree or the pasture component into previously single-use lands. Many NRPs familiar with silvopasture expressed

that “silvopasture isn’t for everyone.” The improvement of information channels between NRPs, especially NRPs who primarily work with forest landowners (e.g. state forestry service and registered foresters), can ensure that the landowners who inquire about silvopasture make contact with silvopasture-proficient NRPs and then make an educated evaluation.

Areas to target silvopasture education for landowners are those where forestland grazing has been practiced historically, where landowners typically manage cows and timber on separate tracts, and where objectives of the landowner include multiple income streams. Where livestock and timber are not typically mixed and open pasture is the norm, silvopasture is not likely to resonate with local landowners.

Opportunities for future work include investigating effective methods of landowner engagement around silvopasture especially in areas where NRPs perceive that physiography (e.g. climate, soils, topography) and landowners are appropriate. Additionally, we are interested in further exploration of networks of professionals and experienced landowners NRPs utilize and likely build upon in an effort to assist landowners in learning about alternative land uses such as silvopasture. We also want to explore to what extent is silvopasture perceived similarly across physiographic regions. To that end, we hope to compare our findings on NRPs’ engagement with landowners in other states or regions in temperate North America.

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Chapter 5 Conclusion

I first became interested in silvopasture because it offers landowners with appropriate resources and objectives a sustainable conservation practice, yielding social, economic, and environmental benefits. The high number of private landowners in the Southeast and the extent of acreage they control makes this discussion particularly important. Aging forest landowners, land succession concerns, and rural community and economic transition makes innovation in sustainable private forest management a timely concern. All three objectives of my research stemmed from a desire to understand the current practice of silvopasture in four Southeastern states and regard for silvopasture among natural resource professionals (NRPs) and landowners. Garrett et al. (1994) identified multiple constraints to agroforestry adoption across the U.S. In 2014-2016, approximately 20 years after Garrett et al. (1994), this present research assesses the continued relevance of these barriers. In conclusion to the three studies of silvopasture in the Southeast, I summarize my findings and their significance in light of several of the constraints Garrett et al. (1994) identified.

Familiarity

Garrett et al. (1994) pointed to the constraint that a lack of familiarity, uncertainty, and risk on the part of NRPs and landowners put on agroforestry. My results indicate that marked strides have taken place in NRPs' education around silvopasture in the Southeast since Garrett et al. (1994) and Workman (2003). NRPs familiarity has increased since Workman et al. (2003) found that NRPs reported "lack of familiarity with the practices" and "lack of demonstrations" as

"very important" obstacles to the practice of agroforestry. We found that 64 % of NRPs reported being "somewhat familiar" with silvopasture and an additional 19 % were "very familiar" (Table 2). The greatest familiarity was within the NRCS, and the states of Alabama and Florida, with the least being in Mississippi and within the state forestry services and registered foresters. One area NRPs are not familiar with is the cost-share funds available from the NRCS and the 2014 Farm Bill, a knowledge gap which constrains the potential positive impact of a supportive policy environment.

Despite reporting "somewhat familiar" with silvopasture overall, misunderstandings about silvopasture persisted, including misunderstandings about species components, landowners appropriate for silvopasture, even about what constitutes a silvopasture. Evidence from our qualitative interviews and quantitative survey suggest that some landowners and NRPs misconstrue particular components or applications within silvopasture as essential components. For example, an NRP in Mississippi, when asked why he perceived that silvopasture was inappropriate for his physiographic region (e.g. climate, soils), answered, "Because longleaf is not native here." While this NRP reports being "somewhat familiar" with silvopasture, his response indicates that he has likely misinterpreted the fact that longleaf pine is only one of several species compatible with silvopasture. Similarly, a cattleman who leased land in silvopasture to graze his herd was unfamiliar with the practices of intensive rotational grazing and silvopasture before he leased this parcel. In our interview, his comments indicated that he believed rotational grazing to be essential. In this case, he has grouped these two practices together. The Silvopasture.org online training course discusses rotational grazing in silvopasture quite extensively, as do some silvopasture demonstration sites use rotational grazing, which may lead to learners' interpretation that rotational grazing is essential to a silvopasture (Hamilton

2008). Based on these results, silvopasture training materials should be revisited and amplified. For example, including illustrations of different silvopasture systems in settings that are similar across regions will address the misconception that silvopasture has a prescribed formula (e.g. species, arrangement, etc.) A few NRPs confused unmanaged woodland grazing, which is too often overgrazing, with silvopasture.

Silvopasture has been promoted as a practice well-suited for minority and limited resource landowners and farmers. This racially-stratified historic and present context of Southeastern agriculture is particularly tied to the livestock component and the size of land holdings: minority landowners and the 1890s Land Grant Universities in the Southeast predominantly work with goats. Thus, one NRP believes that this positioning of silvopasture as a land management system for minority and limited resource landowners has constrained the adoption of silvopasture for other landowner groups. “It kind of got put over here in this outreach kind of scenario and stayed there I think for several years it never quite got out of that box--this is something that minority landowners should be involved with but the regular real-world forestry out here it doesn't apply--so for years I think it stayed there.” Several factors indicate that silvopasture is no longer in the “box” this NRP observed, included reported familiarity with silvopasture among the general population of NRPs, NRPs perceptions of the familiarity with silvopasture of the landowners they work with and the number of landowners inquiring to NRPs about silvopasture.

Silvopasture policy environment

Schultz et al. (1995) and Garrett et al. (1994) described a policy climate that constrained practice and adoption of agroforestry and called for future USDA policy and procedures to permit or explicitly encourage agroforestry. One major task outlined in the Agroforestry

Strategic Framework is to incorporate agroforestry into USDA policies, programs, and procedures (USDA 2011) to rectify the previously unclear or constraining policy environment of agroforestry Garrett et al. (1994). One cost share program, the CRP, that had previously limited the practice of silvopasture is now an opportunity to expand it.

Expiring CRP opportunity

We recommend an immediate and targeted effort to communicate the option of silvopasture to landowners with expiring CRP contracts who may be enticed by the EQIP cost-share available for establishing silvopastures. Additionally, landowners who express interest in pine straw harvesting may be candidates for silvopasture, as they are seeking to enhance their bases of financial and natural capital simultaneously by intensifying their land management. This region-specific approach is distinctly different than the currently common method of introducing the topic of agroforestry to landowners in a newsletter by outlining the five agroforestry practices and providing examples from across the country. Those advising landowners about silvopasture and agroforestry should consider a place-based approach, emphasizing historical land use practices and financial and natural legacy outcomes.

From the qualitative examples of NRPs stating that many of the best sites for SP are lands transitioning out of CRP and can use EQIP, there is good evidence of positive change in the policy environment supporting silvopasture since 1995. Unfortunately, NRPs outside the NRCS are not yet aware that the NRCS currently has cost-share programs that apply to silvopasture. The overwhelming number of cooperative extension gents (78 %), state forestry service (67 %) and registered forester (80 %) NRPs answered “I don’t know” when asked if there was cost share available for landowners interested in silvopasture. This is an opportunity to increase education and update training materials. Also interesting, 5 % of all NRPs (including 7 % of NRCS agents)

answered “no,” likely reflecting that the knowledge dates back to the era of Garrett et al. (1994) and Schultz et al. (1995), when former cost share programs (e.g. CRP) excluded silvopasture.

Landowner legacy objectives

Much has been made about the aging population of farmers and landowners (Butler 2008; Bailey et al. 2014; Flora et al. 2015; Butler et al. 2016). Many landowners who manage timber, especially in timber-productive areas, place a strong value on legacy: leaving the land better than it was when they received it, ecologically and economically (Butler 2008). Legacy goals emerged as important drivers of silvopasture adoption (see chapter two). This finding counters the constraint identified by Garrett et al. (1994), that landowners were adverse to adopting agroforestry systems with rotation lengths which will likely exceed their life expectancy. For example, one retired landowner who currently rakes pine straw under twelve-year-old longleaf pine, prunes his trees himself despite a physical disability, and who plans to practice silvopasture after thinning said, “I won’t see the full benefit of these trees, but maybe my grandchildren will. The benefit for me is in the pine straw and in a few years, in the cows.”

Agroforestry (e.g. silvopasture and pine straw harvesting) offers older timber producers the opportunity to receive short-term benefit for themselves while growing a natural and financial legacy for their children and grandchildren. This represents an important increase in human capital for rural, retired, older landowners, who invest in meaningful, productive, informal work on-farm as their off-farm fulfilling activities wane. At the time they risk feeling “put out to pasture,” they are finding their purpose in creating a legacy through silvopasture. This finding demonstrates that for a portion of the aging landowner population rotation length compared to life expectancy (Garrett et al. 1994) is not a barrier, but in fact an impetus to practice silvopasture because they see silvopasture as a tool for achieving their legacy objectives.

That is, of course, only a if landowners articulate their legacy objectives to their trusted NRPs. Most NRPs are trained to privilege economic objectives which may not align with landowner legacy objectives. This is an area for further investigation and NRP training.

The NRP perception that landowners would be unwilling to follow agroforestry management plans (Garrett et al. 1994) was still be true for NRPs in some places. In short, with regard to where landowners are amenable to successfully practice silvopasture, culture trumped physiology. This is a people- and place-based determinant; what was culturally normative was biologically possible, and places where it was not normative but was biologically possible, other land uses were practiced. We found that NRPs in areas forestland grazing has been practiced historically were most likely to believe that silvopasture was appropriate for many of their landowners. Additional enabling factors are areas where landowners typically manage cows and timber on separate tracts, and where objectives of the landowner include multiple income streams and leaving a legacy for heirs. Where livestock and cattle are not typically mixed and open pasture is the norm, silvopasture is not likely to resonate with local landowners. Technically, for landowners who currently manage cattle and timber on different tracts, silvopasture does not diversify income streams but does offer the ability to expand or contract livestock and timber production in response to changes (e.g. cattle and timber markets, available labor, landowner objectives). This flexibility was valuable to several landowners we interviewed. Intensity of management is influenced by both the physiographical capacity of the land and local culture, which reinforces that land use change must account for place and people (Bridger and Alter 2006). Further, when NRPs described why they perceived silvopasture to be appropriate to their landowners, the results underscored the principle that land use recommendations must be tailored to the objectives, resources, and constraints of individual landowners. Considering all

perceived barriers, NRPs see substantial reasons to not recommend the practice of silvopasture to many landowners. Indeed, based on landowner financial, natural, human, and cultural capital resources required, silvopasture is inappropriate for many. However, for landowners who have land in both livestock pasture and timber, and sufficient financial resource and social capital to access the technical assistance they need, many NRPs saw silvopasture as an effective way to extend either the tree or the pasture component into previously single-use lands. NRPs familiar with silvopasture commonly expressed that "silvopasture isn't for everyone." The improvement of information channels between NRPs, especially NRPs who primarily work with forest landowners (e.g. state forestry service and registered foresters), can ensure that the landowners who inquire about silvopasture make contact with silvopasture-proficient NRPs and then make an educated evaluation.

In addition to correcting misunderstandings about silvopasture, the planning of future silvopasture training should focus on areas where silvopasture is physiographically appropriate and landowners commonly manage cattle and trees together. Training should be targeted at state forestry service NRPs, especially those in Alabama and Mississippi. Ideally, training should be done in conjunction with local NRCS, who may educate on financial incentives and provide information. Strengthening ties between state forestry service and local NRCS may facilitate landowners' access to cost-share programs and other forms of technical assistance.

My results reinforce the need to target to silvopasture outreach to people and places where conditions are most conducive to silvopasture success. Namely, places where silvopasture is biophysically and culturally appropriate. We found that a crucial cultural capital asset was related to the acceptability of combining cattle and timber. In areas where landowners manage cattle exclusively, and do not manage timber (e.g. North Alabama), NRPs were resistant to

silvopasture. However, in communities where many landowners manage both cattle and timber and there is a cultural memory of the practice of historical woodland grazing (e.g. the Coastal Plain), silvopasture is culturally appropriate. In fact, our results indicated that landowners were not interested in silvopasture per se but in a land use that is culturally appropriate and congruous with their objectives and site characteristics, and found silvopasture to fit their social milieu. In these cases, landowner and community assets are spiraling up, as human capital, engagement in community, natural capital, cultural capital (e.g. people-and place-based connections through this historical land use). The increase of all of these capitals are predicated on social capital, which bonds landowners to each other and to local NRPs, and links community members with outside knowledge and support. While I came to this project interested in silvopasture and found it to meet some landowners' contexts, landowners brought their context and were delighted to find a management system which addresses all of their objectives and develops their resources.

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APPENDIX 1

Silvopasture survey

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)
INFORMATION LETTER for a Research Study entitled "Assessment of the attitudes and practices of land management professionals with regard to silvopasture"

You are invited to participate in a research study to understand the perceptions of professionals like yourself of silvopasture, an agroforestry practice. The study is being conducted by Dr. Becky Barlow in the Auburn University School of Forestry and Wildlife Sciences. You are invited to participate because you are a professional who advises private landowners and are age 19 or older.

Your participation is completely voluntary. If you decide to participate in this research study, you will be asked to complete a questionnaire. Your total time commitment will be approximately 15 minutes. The risk associated with participating in this study is breech of confidentiality. To minimize this risk, we will keep your responses confidential. If you participate in this study, you can expect to enjoy sharing your experiences and perspective on an important land management topic. We cannot promise you that you will receive any or all of the benefits described. Benefits to others may include enhancing the silvopasture outreach resources available to professionals like you and the landowners you serve. If you change your mind about participating, you can withdraw at any time by closing your browser window. If you choose to withdraw, your data can be withdrawn as long as it is identifiable. Once you've submitted anonymous data, it cannot be withdrawn since it will be unidentifiable. Your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University or the School of Forestry and Wildlife Sciences. Any data obtained in connection with this study will remain anonymous. We will protect your privacy and the data you provide by storing data on a password protected computer in a locked office. Information collected through your participation may be used to fulfill an educational requirement, published in a professional journal, and/or presented at a professional meeting. If you have questions about this study, please contact Becky Barlow at rjb0003@auburn.eduIf you have questions about your rights as a research participant, you may contact the Auburn University Office of Research Compliance or the Institutional Review Board by phone (334) 844-5966 or e-mail at IRBadmin@auburn.edu or IRBChair@auburn.edu.

HAVING READ THE INFORMATION ABOVE, YOU MUST DECIDE IF YOU WANT TO PARTICIPATE IN THIS RESEARCH PROJECT. IF YOU DECIDE TO PARTICIPATE, PLEASE CLICK ON THE LINK BELOW. YOU MAY PRINT A COPY OF THIS LETTER TO KEEP.
Investigator Becky Barlow Date 10/31/14
Co-Investigator Emily Stutzman Jones Date 10/31/14

The Auburn University Institutional Review Board has approved this document for use from October 6, 2014 to October 5, 2015. Protocol #14-445 EP 1410

The most common form of agroforestry in the southeastern United States is silvopasture, or managing for timber, forage, and livestock on the same parcel of land. It is designed to produce high-quality timber while providing forage and shade for livestock.

Are you an agricultural or land management professional who gives advice to private landowners or farmers about their management practices and are over the age of 19?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To End of Survey

How would you rate your familiarity with silvopasture?

- ❍ Not at all familiar (1)
- ❍ Somewhat familiar (2)
- ❍ Neither unfamiliar nor familiar (3)
- ❍ Somewhat familiar (4)
- ❍ Very familiar (5)

Generally, how would you rate the familiarity of your professional colleagues with silvopasture?

- ❍ Not at all familiar (1)
- ❍ Somewhat familiar (2)

- ❍ Neither unfamiliar nor familiar (3)
- ❍ Somewhat familiar (4)
- ❍ Very familiar (5)

When you consider the landowners and farmers you typically work with, how familiar do you think they are with silvopasture?
- ❍ Not at all familiar (1)
- ❍ Somewhat familiar (2)
- ❍ Neither unfamiliar nor familiar (3)
- ❍ Somewhat familiar (4)
- ❍ Very familiar (5)

Where have you learned about silvopasture? Check all that apply.
- ❑ Published scientific research (1)
- ❑ Field days or educational workshops (2)
- ❑ Websites (3)
- ❑ Informational or educational publications (4)
- ❑ Professional colleagues (5)
- ❑ Landowners (6)
- ❑ Other (7) _____

Have you ever participated in a silvopasture field day or other training event related to silvopasture?
- ❍ Yes (1)
- ❍ No (2)

Answer If Have you ever participated in a silvopasture field day or other training event related to silvopa... Yes Is Selected
Did you go away from the training feeling like silvopasture was appropriate for you professionally and for the landowners you advise?
- ❍ Yes (1)
- ❍ No (2)

Answer If Have you ever participated in a silvopasture field day or other training event related to silvopasture? Yes Is Selected
Why or why not?

How appropriate is silvopasture for the average farmer and landowner where you work?
- ❍ Not at all appropriate (1)
- ❍ Somewhat inappropriate (2)
- ❍ Neither inappropriate nor appropriate (3)
- ❍ Somewhat appropriate (4)
- ❍ Very appropriate (5)

Why?

How appropriate is silvopasture for the physiographic region (e.g. climate, soils, vegetation) where you work?
- ❍ Not at all appropriate (1)
- ❍ Somewhat inappropriate (2)
- ❍ Neither inappropriate nor appropriate (3)

- ❍ Somewhat appropriate (4)
- ❍ Very appropriate (5)

Why?

Has a farmer or landowner ever asked you for assistance with establishing or managing all or part of their land as a silvopasture?
- ❍ Yes (1)
- ❍ No (2)

Answer If Has a farmer or landowner ever asked you for advice about establishing or managing all or part of... Yes Is Selected
What kind of assistance did you provide to landowners seeking your advice about establishing or managing silvopastures? Check all that apply. (What else should I include?)
- ❑ Referred to other professional specialists (besides the NRCS or cooperative extension specialists) (1)
- ❑ Referred to the NRCS (2)
- ❑ Referred to cooperative extension specialists (3)
- ❑ Provided printed information (4)
- ❑ Provided technical assistance (5)
- ❑ Assisted with the development of a land management plan (6)
- ❑ Visited the landowner's site (7)
- ❑ Other (8) _____
- ❑ Referred to the USDA National Agroforestry Center (9)
- ❑ Referred to websites. Please list or describe. (10) _____

Answer If Has a farmer or landowner ever asked you for advice about establishing or managing all or part of their land as a silvopasture? Yes Is Selected
How many landowners or farmers would you say have asked you for assistance with establishing or managing all or part of their land as a silvopasture in the last five years?

If a farmer or landowner came to you today in search of assistance for establishing a silvopasture, what would you provide?
- ❑ Referral to other professional specialists (besides the NRCS or cooperative extension specialists). (1)
- ❑ Referral to the NRCS (2)
- ❑ Referral to cooperative extension specialists (3)
- ❑ Provide printed information (i.e. publications) or referred to websites (4)
- ❑ Provide technical assistance (5)
- ❑ Referral to the USDA National Agroforestry Center (6)
- ❑ Visit the landowner's site (7)
- ❑ Other (8) _____

If a farmer or landowner came to you in search of information and technical assistance for establishing a silvopasture, which other experts would you coordinate with to assist the farmer or landowner?
- ❑ Livestock/forage specialist (1)
- ❑ Forestry specialist (2)
- ❑ Agroforestry professional (3)
- ❑ Cooperative extension specialist (4)
- ❑ NRCS district conservationist (5)

❑ Other (6) _____

Are there any USDA NRCS cost share programs available for landowners in your area who wish to convert all or part of their land to silvopasture?
❍ Yes (1)
❍ I'm not sure (2)
❍ No (3)

Answer If Are there any USDA NRCS cost share programs available for landowners in your area who wish to convert all or part of their land to silvopasture. Yes Is Selected
What programs are available?

Answer If Are there any USDA NRCS cost share programs available for landowners in your area who wish to convert all or part of their land to silvopasture. Yes Is Selected
What practices may these programs cover?
❑ Purchase of seedlings (1)
❑ Tree planting (2)
❑ Cross fencing (3)
❑ Perimeter fencing (4)
❑ Water systems (5)
❑ Other (6) _____

What types of landowner is silvopasture best suited for? Please rank the following.
_____ Livestock managers who wish to expand their pasture into current timberland (1)
_____ Limited-resource or minority landowners (2)
_____ Small-scale forest land owners (3)
_____ Absentee landowners who wish to lease their land to livestock producers (4)
_____ Timber managers who desire short-term income streams (5)
_____ Other (6)

In your opinion, what is the minimum number of acres necessary to have a viable silvopasture?
❍ There is no minimum (1)
❍ 10-50 acres (2)
❍ 51-100 acres (3)
❍ 101-200 acres (4)
❍ 201-300 acres (5)
❍ More than 300 acres (6)

A tract of land is typically converted to a silvopasture in one of two ways. Which of the following methods do you prefer?
❍ Thinning an existing stand of timber (1)
❍ Planting trees in an existing pasture (2)
❍ I have no preference (3)

Answer If Why is planting trees in an existing pasture a better option than thinning an existing stand of timber? Is Selected
Why do you think that thinning an existing stand of timber is a better option than planting trees in an existing pasture?

Answer If A tract of land is typically converted to a silvopasture in one of two ways. Which method of esta... Planting trees in an existing pasture Is Selected

Why do you think that planting trees in an existing pasture is a better option than thinning an existing stand of timber?

Silvopastures can produce multiple marketable products. How do you rate the following sources of income from a silvopasture? Rank in order of importance. Income from:
_____ Livestock sales (1)
_____ Timber sales (2)
_____ Hunting leases (3)
_____ Grazing leases (4)
_____ Pine straw production (5)

In order of importance, what do you think are the most important obstacles for landowners of having land in silvopasture?

	very important (1)	important (2)	neither important nor unimportant (3)	unimportant (4)	Very Unimportant (5)
Livestock damage trees (1)	❍	❍	❍	❍	❍
Component competition (2)	❍	❍	❍	❍	❍
Lack information (3)	❍	❍	❍	❍	❍
Lack markets (4)	❍	❍	❍	❍	❍
Expense of management (5)	❍	❍	❍	❍	❍
Lack familiarity (6)	❍	❍	❍	❍	❍
Lack technical assistance (7)	❍	❍	❍	❍	❍
Lack demonstration (8)	❍	❍	❍	❍	❍
Lack financial incentive (9)	❍	❍	❍	❍	❍
Eliminates options of other land uses (10)	❍	❍	❍	❍	❍
Length of wait time from planting trees in an existing pasture till trees can be	❍	❍	❍	❍	❍

harvested (11)					
Length of wait time from planting trees in an existing pasture till livestock may be permitted to graze (12)	❍	❍	❍	❍	❍

Please indicate to what extent you agree or disagree with the following statements about ecological aspects of silvopasture.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Enhancing ecological sustainability through diversified agricultural production systems is an important goal. (1)	❍	❍	❍	❍	❍
Improving the economic and ecological balance of agricultural systems is an important goal. (2)	❍	❍	❍	❍	❍
Silvopasture can increase soil moisture through the inclusion of trees. (3)	❍	❍	❍	❍	❍
Some cool season grasses may increase production under reduced light intensities in silvopasture. (4)	❍	❍	❍	❍	❍

Livestock need shade during the heat of the day. (5)	❍	❍	❍	❍	❍
Silvopasture can increase daylight grazing during hot summer months. (6)	❍	❍	❍	❍	❍
Shading from trees reduces forage quantity. (7)	❍	❍	❍	❍	❍
Shading from trees improves the nutritional quality of forage. (8)	❍	❍	❍	❍	❍
Soil compaction is an important concern with silvopasture management. (9)	❍	❍	❍	❍	❍
Soil moisture is a major limiting factor in cool season forage production. (10)	❍	❍	❍	❍	❍
Increasing the number of forested acres is an important goal. (11)	❍	❍	❍	❍	❍
Restoring the native forestland of my region is an important goal. (12)	❍	❍	❍	❍	❍
Enhancing wildlife	❍	❍	❍	❍	❍

habitat on agricultural lands is an important goal. (13)					

Please indicate to what extent you agree or disagree with the following statements about the economics of silvopasture.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Silvopasture systems can help reduce financial risk for producers by diversifying income streams. (1)	❍	❍	❍	❍	❍
Silvopasture systems produce higher profit margins than forage livestock production alone. (2)	❍	❍	❍	❍	❍
Diversifying agricultural systems is important from a financial standpoint. (3)	❍	❍	❍	❍	❍
Livestock producers primarily manage for maximum annual returns per acre. (4)	❍	❍	❍	❍	❍
It is important to have an economically diversified	❍	❍	❍	❍	❍

farm or land base. (5)					
The cost of physical infrastructure (e.g. fencing, water systems) is a major barrier to landowners interested in silvopasture. (6)	❍	❍	❍	❍	❍

Please indicate to what extent you agree or disagree with the following statements about the farmers and landowners you work with.

	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly Agree (5)
Livestock producers are generally opposed to adopting intensively managed livestock systems. (changed wording) (1)	❍	❍	❍	❍	❍
Timber producers are generally opposed to adopting land management systems that include livestock. (changed wording) (2)	❍	❍	❍	❍	❍
Silvopastures are visually more attractive than traditional pastures. (3)	❍	❍	❍	❍	❍
Aesthetics are not a primary consideration in agricultural	❍	❍	❍	❍	❍

producers' decision making. (4)					
Land management innovations are generally viewed with skepticism by the landowners I typically work with. (changed wording) (5)	❍	❍	❍	❍	❍
The landowners I work with are looking for new options for land management. (6)	❍	❍	❍	❍	❍
Many private landowners are interested in enhancing wildlife habitat while receiving income from a complementary land use. (new question) (7)	❍	❍	❍	❍	❍

The following background questions will help us understand you better.

In what year were you born?

What is your gender?
❍ Male (1)
❍ Female (2)

How would you classify your field of study? In other words, what did you major in? Check all that apply.
❑ Agronomy/soils/crop science (1)
❑ Forestry (2)
❑ Wildlife (3)
❑ Natural resource management (4)
❑ Animal science/livestock management (5)
❑ Horticulture (6)
❑ Agricultural economics (7)
❑ Environmental science (8)

❑ Other (9) _____

What is the programming area that best describes your current work?
❍ Row crops (1)
❍ Horticulture (2)
❍ Livestock (3)
❍ Forestry (4)
❍ Forages (5)
❍ Farm business management (6)
❍ Wildlife (7)
❍ Other (8) _____

Do you currently manage all or part of your personal land in a silvopasture?
❍ Yes (1)
❍ No (2)

How many years have you been employed as a natural resource professional?

Dr. Becky Barlow, Alabama Cooperative Extension Specialist at Auburn University, is planning a silvopasture training workshop in conjunction with this research project. This workshop will be held in the fall of 2014. Would you like to receive information about attending that workshop via email?
❍ Yes (1)
❍ No (2)

On what topics related to silvopasture do you need information the most?
❑ Designing and establishing silvopastures (1)
❑ Livestock management (2)
❑ Timber management (3)
❑ Tree species selection (4)
❑ Forage species selection (5)
❑ Interactions between livestock and trees (6)

What topics would you be most interested in learning about at a silvopasture training workshop?
❑ Silvopasture design and establishment (1)
❑ Timber management in silvopastures (2)
❑ Livestock management in silvopatures (3)
❑ Forage management in silvopasture (4)
❑ Advising landowners about silvopasture (5)

Thank you for taking the time to complete this questionnaire. Your participation is greatly appreciated! If you would like to receive a copy of the results from this survey, please contact Dr. Becky Barlow, Extension Forester in the School of Forestry and Wildlife Sciences at Auburn University at (334) 844-1019 or at the following email address: becky.barlow@auburn.edu. It may take us some time to compile the results, but in appreciation for your time and efforts we would be happy to share with you what we have learned.
Please feel free to write any comments or suggestions you have in the space below:

APPENDIX 2

Survey Sample: 1038 individuals
October 4, 2014
Databases created, pre-notice letters ready to send out.
Cooperative extension (total: 438)

- AL: 105 agents, Natural Resources and Animal Science
- GA: 74 from CAES Sustainable Agriculture and Organic Production Directory, 121 county coordinators (80%) and a regional coordinator will email it to her Agriculture and Natural Resources listserv.
- FL: 54 agents, 80% of county directors
- MS: 84 agents, 66% of county extension agents (excluded 4H/Youth, nutrition, and family resources agents when that information was available)

Registered foresters (total: 214)

- AL: 37 Association of Consulting Foresters members
- GA: 30 Association of Consulting Foresters members; 103 registered foresters
- FL: 11 Association of Consulting Foresters members
- MS: 33 Association of Consulting Foresters members

State foresters (total: 139)

- AL: 20 Alabama Forestry Commission
- GA 36 Georgia Forestry Commission (Approximately 80% of counties)
- FL: 37 County foresters, Florida Forest Service (Approximately 80% of counties
- MS: 46 Mississippi Forestry Commission foresters (5 of 7 regions – NE, SC, EC, SE, Capital)

NRCS (total: 247)

- AL: 51 Approximately 80% of DCs and other conservationists (resource and soil), state conservationists (but not area)
- GA: 48 Approximately 80% of counties DCs and other conservationists (not state or area)
- FL: 62 Approximately 80% of DCs and other conservationists (resource and soil), state conservationists, area conservationists
- MS: 86 Approximately 80% of DCs and other conservationists (resource and soil), state conservationists, district, area conservationists

Totals by state:
Alabama: 213
Georgia: 412

Florida: 164
Mississippi: 249
Random number generators were used to select counties to be included in the sample. When numbers are approximate it is because in a few cases, 2-4 counties are combined.

APPENDIX 3

AUBURN UNIVERSITY

SCHOOL OF FORESTRY
AND WILDLIFE SCIENCES

September 12, 2014

Dear Sir or Madam,

You are invited to participate in a research study to understand the adoption of silvopasture, an agroforestry practice, in the Southeast. The goal of this study is to understand the perspectives of land management professionals on silvopasture as a land use. Additionally, we are interested in understanding how land management professionals advise private landowners about silvopasture. The study is being conducted by Becky Barlow, associate professor in the Auburn University School of Forestry and Wildlife Sciences. You were selected as a possible participant because you are and are age 19 or older and you are currently employed as a land management professional with [the Alabama Cooperative Extension; Natural Resources Conservation Service, The Alabama Forestry Commission; The U.S. Forest Service].

If you decide to participate in this research study, you will be asked to participate in an online questionnaire. In the next few days you will receive an email at your professional email address with a link to the survey. If the description above does not fit you, it will help us greatly if you follow the questionnaire link anyway and click "no" to the first question, which will take you to the end of the questionnaire.

Your total time commitment will be approximately 15 minutes. Your participation is completely voluntary and your decision about whether or not to participate or to stop participating will not jeopardize your future relations with Auburn University or the School of Forestry and Wildlife Sciences. Any information obtained in connection with this study will remain confidential. Information obtained through your participation may be used to fulfill an educational requirement, published in a professional journal, presented at a professional meeting, or used to develop outreach materials. If you change your mind about participating, you can withdraw at any time during the study. If you choose to withdraw, your data can be withdrawn as long as it is identifiable.

If you have questions about this study, please contact me at the information below. If you have questions about your rights as a research participant, you may contact the Auburn University Office of Human Subjects Research or the Institutional Review Board by phone (334)-844-5966 or e-mail at hsubjec@auburn.edu or IRBChair@auburn.edu.

I also hope that you enjoy the experience and the opportunity to voice your thoughts and opinions about silvopasture in the Southeast. This research can only be successful with the generous help of people like you.

Sincerely,

Dr. Becky Barlow
Alabama Cooperative Extension System Specialist
School of Forestry and Wildlife Sciences
(334) 844-1019
rjb0003@auburn.edu

3301 FORESTRY AND
WILDLIFE SCIENCES BUILDING
AUBURN, AL 36849-5418

www.auburn.edu

APPENDIX 4

Dear ${m://FirstName} ${m://LastName},

About two weeks ago a questionnaire was emailed to you because you are an agricultural or natural resources professional who advises farmers or landowners about their land use decisions. This questionnaire is part of an important study about silvopasture, an agroforestry practice, in the Southeastern U.S. To the best of my knowledge, it's not yet been returned.

If you have already completed and submitted the survey, please accept my sincere thanks. If not, I hope that you will fill out and return the questionnaire soon. This research can only be successful with the generous help of people like you.
Follow this link to the Survey:
${l://SurveyLink?d=Take the Survey}
Or copy and paste the URL below into your internet browser:
${l://SurveyURL}

Sincerely,

Dr. Becky Barlow

Alabama Cooperative Extension System Specialist
Auburn University School of Forestry and Wildlife Sciences

APPENDIX 5

Follow-up postcard text:

Hi ${m://FirstName} ${m://LastName},

You should have received a questionnaire by email because you are an agricultural or natural resources professional who advises farmers or landowners. We're studying silvopasture, an agroforestry practice, in the Southeastern U.S. If you have already completed and submitted the survey, thank you! If not, please do so at your earliest convenience. Thank you for the work you do and your help with this effort!
Here's the link: ${l://SurveyURL}

Best,
Dr. Becky Barlow
Alabama Cooperative Extension System Specialist
Auburn University School of Forestry and Wildlife Sciences

APPENDIX 6

	Mann-Whitney U			Kurskal-Wallis H (by professional catego			
	Median	p-value		p-value		Significant pairwise comparisons	Test statistic
Enhancing ecological sustainability through diversified agricultural production systems is an important	4	0.001	***	0.007	**	4:1	12.265
Improving the economic and ecological balance of agricultural systems is an important goal	4	0.001	***	0.012	*	4:1 (p	10.904
Silvopasture can increase soil moisture through the inclusion of trees	3	0.021	*	0.429			
Some cool season grasses may increase production under reduced light intensities in silvopasture	3	0.673		0.031	*		8.879
Livestock need shade during the heat of the day	4	0.106		0.016	*	4:2 (p.029)	10.283
Silvopasture can increase daylight grazing during hot summer months	4	0.018	*	0.301			
Shading from trees reduces forage quantity	4	0.248		0.595			
Shading from trees improves the nutritional quality of forage	3	0.062		0.146			
Soil compaction is an important concern in silvopasture management	4	0.493		0.001	***	1:4	17.291
Soil moisture is a major limiting factor in cool season forage production	4	0.012	*	0.001	***	2:3	17.291
Increasing the number of forested acres is an important goal	3	0.013	*	0.001	***	1:3	23.861
Restoring the native forest land of my region is an important goal	3	0.002	**	0.01	**	4:3	11.395
Enhancing wildlife habitat on agricultural lands is an important goal	4	0.168		0.042	*	4:1	8.22
Silvopasture systems can help reduce financial risk for producers by diversifying income streams	4	0.001	***	0.167			
Silvopasture systems produce higher profit margins than forage livestock production alone	3	0.001	***	0.914			
Diversifying agricultural systems is important from a financial standpoint	4	0.001	***	0.087			
Livestock producers primarily manage for maximum annual returns per acre	4	0.879		0.349			
It is important to have an economically diversified farm or land base	4	0.001	***	0.063			
The cost of physical infrastructure (e.g. fencing, water systems) is a major barrier to landowners interested in silvopasture	4	0.15		0.044	*	3:4 (p=.045)	8.085
Livestock producers are generally opposed to adopting intensively managed livestock systems	3	0.921		0.001	***	3:2	24.846
Timber producers are generally opposed to adopting land management systems that include livestock	4	0.755		0.385			
Silvopastures are visually more attractive than traditional pastures	4	0.064		0.077			
Aesthetics are not a primary consideration in agricultural producers decision making	3	0.601		0.957			
Land management innovations are generally viewed with skepticism by the landowners I work with	3	0.347		0.003	**	3:2	14.221
The land owners I work with are looking for new options for land management	3	0.001	***	0.744			
Many private landowners are interested in enhancing wildlife habitat while receiving income from a complimentary land use	4	0.054		0.009	**	1:3 (p=.005); 2:3	11.609