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## **Integrated Timber, Forage and Livestock Production - Benefits of Silvopasture<sup>1</sup>**

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What is silvopasture, and what benefits does it offer to landowners throughout the Southeast? Silvopasture, an agroforestry practice, is an intentional combination of trees, forage plants and livestock. The term 'silvopasture' translates into 'forest-pasture', as the prefix 'silvo' was derived from a Latin word that means 'forest'. The system offers advantages described below, but requires intensive management. Silvopasture can be established either by planting trees in an improved pasture, or by thinning a tree stand and planting improved forage. Special tree arrangements in silvopastures allow for tree and forage growth, as well as for grazing livestock. This publication explains potential benefits and drawbacks of silvopastoral systems. It also describes steps for choosing appropriate tree, forage and livestock species. For details concerning silvopasture design and establishment, please see Florida Cooperative Extension Service fact sheet: *Establishing Silvopasture in North Florida* (currently in preparation). Other relevant University of Florida, IFAS, extension publications on the subject are: *Managing Pine Trees and Bahiagrass for Timber and Cattle Production* (Circular 1154) and *Managing Cattle on Timberlands: Forage Management*

(SS-FOR-20). These and other University of Florida electronic extension publications are available at <http://edis.ifas.ufl.edu/>.

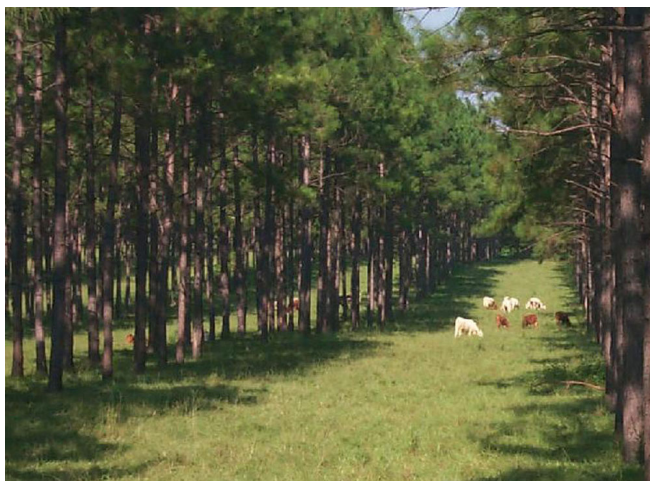
### **Why Consider Silvopasture?**

Production of timber, forage and livestock in the same place, at the same time is viewed as an attractive management alternative that has potential to improve cash flow for landowners (Figure 1).

The goal in silvopastoral systems is to optimize, rather than maximize, production of all three components. A well-designed and properly managed silvopasture can be more economically attractive than plantation forestry under a wide range of conditions. This has been demonstrated in pine-based systems in north Florida, Louisiana, Mississippi, and Georgia, as well as in Douglas fir-based silvopastures of western Oregon. The key to improved cash flow of silvopastures is the annual income derived from forage and livestock, which supplements long-term, periodic income from timber sales. The multi-product nature of silvopastures provides safeguards against unfavorable markets, weather conditions, or agricultural policy decisions (Sharrow, 1999).

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**Figure 1.** Seventeen-year-old slash pine, bahiagrass, crimson clover, and cattle silvopasture. Trees were planted in double-row 4x8 ft spacing with 40 ft pasture alleys between the double-rows. Bahiagrass dominates alleys during summer and crimson clover during winter months. Credits: Todd Groh, August 2001

Silvopasture can be implemented on small acreages as well as on landholdings with hundreds of acres. It could be a stand-alone operation, or part of a mosaic of land-uses that include improved pastures and diverse timberlands. There is also potential for partnerships between forestland and livestock owners. The forest owners would gain annual income; the livestock owners would have access to an additional grazing resource.

### Who Should Consider Silvopasture?

Applying silvopasture and realizing its potential benefits requires combined expertise in timber, forage and livestock management. Landowners may choose to work alone or combine their own strengths with those of other individuals. Silvopasture establishment could be favorably considered by the following:

- Non-industrial private forest landowners who want annual forest-derived income
- Pine plantation owners who want to diversify income sources after first commercial thinning
- Livestock producers who want to improve grazing conditions of their woodlots

- Livestock producers interested in diversifying their enterprises

### Economics of Silvopasture

Studies from across the Southeast report productive livestock grazing under pine canopies while maintaining, or even improving high value timber production. In northwest Louisiana silvopasture generated a higher internal rate of return than managed timber or open pasture (Clason, 1995).

In southern Mississippi silvopastures attained higher land values than commercial pine plantations.

Optional hunting fees added yet more value to those systems. However, in the same study, grazing for stocker steers on conventional pasture produced the highest land expectation values (Grado *et al.*, 2001). In Georgia, there are examples of enhanced pine growth with controlled grazing (Lewis *et al.*, 1985). Research models show loblolly pine-forage-cattle practices in the Coastal Plain may have up to 70% greater net present value than a pure forestry operation (Dangerfield and Harwell, 1990). These examples suggest that converting timberland to silvopasture could be more economically attractive than adding timber to existing cattle operations. Recently published data (Husak and Grado, 2002) seem to support this conclusion, except for the lowest (5%) interest rate investigated (Table 1).

Equivalent Annual Income (EAI) is often used to compare forestry and agricultural investments. EAI represents a net present value (all revenues minus all costs discounted to the present) of an investment expressed as annual dollar amount. At the lowest interest rate (5%) pine plantation produced the highest EAI and silvopasture was a close second. However, at 7 and 9% interest rate cattle were the most profitable. On average, silvopasture was more profitable than pine plantation, but not as profitable as cattle operations. The reader is cautioned to consider these conclusions in the context of current market conditions and differences in management regimes. For example, one commodity not included in the analyses summarized above is pine straw, which is not produced in loblolly pine plantations.

## Benefits of Silvopasture

When properly implemented, silvopasture can provide many economic and environmental benefits. Some of these are linked, e.g., reduced need for nitrogen fertilization in grass/legume silvopastures leaves more dollars in landowners' pockets, and lowers the risk of ground water contamination with leaching nitrates. Not all benefits will be possible in every silvopastoral system. Some may be more applicable than others to a particular landowner, depending on silvopasture design, level of management, external circumstances, and management objectives. Below is a list of the most common benefits provided by silvopastures:

- Diversified timberland income by added livestock, hay, grazing/hunting proceeds
- Reduced need for chemical or mechanical vegetation control underneath the trees
- Reduced fire hazard in the absence of brush and accumulated fuels
- Reduced need for nitrogen fertilization in grass/legume silvopastures
- Recycled nutrients from animal wastes benefit forage and tree growth
- Eliminated need for separate tree fertilization, if forage is fertilized
- Delayed forage maturity in the fall and earlier green-up in the spring
- Increased livestock protection from summer heat and winter chill
- Improved cover and forage for wildlife
- Increased opportunities for recreation, – e.g., hunting, wildlife watching
- Aesthetically more pleasing than either solid pine plantations or open pastures

## Drawbacks of Silvopasture Establishment

Full benefits of silvopasture may only be realized under intensive management of all three components: trees, forage and livestock. When necessary management for any of these is not possible, silvopasture should not be considered. The system is most suitable for high value and quality timber production during long rotations. If saw timber is not the long-term management objective, other wood production systems should be explored. Similarly to traditional pastures, overgrazing or animal overstocking in silvopastures can damage trees, grazing resource, wildlife habitat or entire watershed. Other drawbacks to silvopasture establishment may include:

- Establishment cost associated with either planting trees in improved pastures, or preparing thinned pine plantations for forage planting
- Need for portable or other fencing before livestock is allowed to graze
- Cost of providing access to water from all grazing cells
- Temporary withdrawal of land from livestock production to avoid damage to young trees
- Temporary interruption of established cattle production cycles during pasture to silvopasture conversion
- Need of additional grazing resources to supplement small acreage silvopastures
- Compromising on tree and forage soil pH and fertilization requirements

## Planning a Silvopastoral System

The key to successful silvopasture establishment and operation is selection of suitable site and well-matched trees, forage and livestock. Intended site needs to be accessible to livestock and able to support tree and forage growth. Selected tree and forage species need to be able to share the existing site resources without much reduction of each others growth. Forage yield under trees must be sufficient

to sustain the livestock. The state-of-the-art silvopastoral systems consist of three integrated and complementary plant components: trees, warm-season, and cool-season forages in addition to livestock. For example, slash pine-Pensacola bahiagrass-crimson clover-roping cattle silvopastures have been successfully implemented in north Florida.

### Tree Species Selection

In the Southeast, all three commercially grown pines – loblolly, slash, and longleaf – are suitable for silvopastoral systems. Of these, slash pine is probably most widely used and suitable because of open crowns, good self-pruning ability, and ease of regeneration. Tree crown characteristics are important both for wood quality and forage production under tree canopies. Loblolly pine is less desirable than slash pine because of its branching and branch retention habits. It also seldom produces high value timber such as poles or veneer, for which silvopasture provides good growing conditions. In addition, loblolly pine needles are seldom used for pine straw mulch, which is another potential product of silvopastoral systems. Longleaf pine has all the desirable characteristics of slash pine, however, this species is more difficult to establish. Pecan is another species that may be locally suitable. When this species is managed to produce nuts, there is ample space for grazing/haying between widely spaced trees. This short list does not explore all of the possible choices. However, trees that meet the following criteria are most suitable:

- Compatible with intended site
- Capable of advancing landowner objectives
- Genetically improved to resist pests and diseases
- Have high value product potential
- Provide non-commodity benefits
- Open-crowned to allow good forage production
- Deep-rooted to avoid competition with forage for moisture

### Forage Species Selection

Studies of warm-season forage species under pine canopies began in south Georgia as early as 1946 (Lewis, 1984). Pensacola bahiagrass was the most shade tolerant of all the warm-season grasses studied. Later studies showed that Pensacola bahiagrass and coastal bermudagrass produced more forage under a tree canopy than carpetgrass or dallisgrass. Other varieties of bahiagrass (Argentine, Tifton-9) may be even better warm-season forages for silvopastoral systems than Pensacola bahiagrass. However, this requires further research.

Cool-season, nitrogen-fixing legumes play an important role in silvopastures. Incorporation of these species into the overall system may reduce the need for nitrogen fertilization of warm-season forage and trees. Crimson, red, arrowleaf, and white clovers, or vetch are examples of cool-season nitrogen fixing species that could be used in silvopastures. Cool-season grasses like ryegrass, rye, wheat, or oats may also be over-seeded in silvopastures between wide-spaced rows of trees. Any cool-season species that provide forage during critical winter months reduces the need for hay and supplemental feeding (Demers and Clausen, 2002). The checklist for forage choices include:

- Suitable for livestock grazing
- Compatible with site (soil, climate)
- Warm- and cool-season forages with little to none overlap in growing seasons
- Productive under partial shade and moisture stresses
- Responsive to intensive management
- Tolerant of heavy grazing

### Livestock Selection

The selection of livestock suitable for a particular silvopastoral system will depend on landowner objectives and markets, as well as tree and forage species established. Beef cattle are the livestock of choice for many landowners. Certain breeds of cattle may fare better in a silvopastoral system than others.

Contact your county livestock extension agent or a Natural Resource Conservation Service (NRCS) in your area for more information. Other than cattle, livestock possibilities include: goats, horses, sheep and deer. Regardless of species selected, grazing should not be undertaken until trees have reached heights that put the main stem terminal buds beyond reach of livestock. Haying between young trees is recommended until the trees are old enough to better withstand pressure from livestock presence and grazing. Browsing animals such as goats, sheep or deer are more likely to eat, while large ruminants such as cattle are more likely to trample young trees. Bulls should be kept out of silvopastures during breeding periods because of higher risk of damage to trees. Generally, younger animals are more likely to damage trees than are older, more experienced ones. Cattle management in pine-bahiagrass systems is discussed in Florida Cooperative Extension Service Circular 1154 (Tyree and Kunkle, 1995). An electronic version of this and other extension publications relevant to timber, livestock and forage management can be found at:  
<http://edis.ifas.ufl.edu/>

### In Summary

Silvopastures are intentional, integrated and intensively managed systems designed to optimize timber, forage and livestock production from the same acreage, at the same time. Silvopastoral systems offer distinct economic and environmental benefits. Among the most important is the possibility of annual revenue, and therefore improved cash flow compared to “timber only” operations. Other advantages from the timber management standpoint include: vegetation control under tree canopies by grazing, and increased tree growth as a by-product of forage fertilization and animal wastes recycling. Silvopastures provide benefits to livestock management as well. There is a longer grazing period compared to open pasture due to earlier green-up and delayed forage maturity under tree canopies. Trees offer shelter to livestock from heat and inclement weather. Other benefits offered by silvopastures include increased wildlife viewing and hunting opportunities, and increased land aesthetic appeal. The most serious drawbacks of silvopastures are the necessity to use fences on forestlands and extending

water to all grazing cells. Planning for a silvopasture requires careful consideration of suitable tree, forage and livestock species for intended sites, local climate, and markets. Selected tree and forage species need to be able to share the existing site resources and produce acceptable growth. The state-of-the-art silvopastoral systems consist of three complementary plant components: trees, warm-season, and cool-season forage species. Beef cattle are usually livestock of choice, but many other animal species are compatible with silvopastoral systems, e.g., goats, horses, sheep and deer.

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**Table 1.** Equivalent Annual Income from loblolly pine-based silvopasture, cattle cow-calf operations, and loblolly pine plantation in 1999 dollars (based on Husak and Grado, 2002).

<b>Interest Rate</b>	<b>Silvopasture</b>	<b>Cattle</b>	<b>Pine Plantation</b>
%	\$/acre		
5	67.06	55.31	69.26
7	51.15	55.01	45.00
9	38.27	53.70	26.62
<b>Average</b>	<b>52.16</b>	<b>54.67</b>	<b>46.96</b>