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Silvopasture in the Western Coastal Plain

Plant Materials Technical Note

Background

In North America, forests have been used for grazing domestic livestock animals since the 1600's. These animals were allowed to roam without intensive management or fencing. However, later in American history, forest grazing was discouraged when research concluded this practice resulted in poor forage production and animal performance along with tree damage. There was also an increased emphasis in the 1920's on southern forestry production with the introduction of pine planting techniques and plantation management. Research combining forages and pines was renewed in the southern United States in the 1940's and has continued since. The southern region of the United States is suited to silvopasture due to its climate, soil, abundant rainfall, and sunlight.

Silvopasture is a management system that integrates timber and forage production for livestock such that each individual system is mutually beneficial to the other. Agronomic practices such as fertilization and rotational grazing are combined with forestry practices such as pruning and thinning in a synergistic approach to enhance production in both systems.

Purpose

The purpose of this technical note is to provide information about silvopasture benefits, design, establishment, and management to Natural Resources Conservation Service field office personnel and land managers in the Western Coastal Plain.

Benefits of Silvopasture

Silvopasture benefits include (but are not limited to):

1. Economic – The use of silvopasture spreads out risk and provides multiple income sources (timber, livestock, and recreation) from the same property.

2. Environmental benefits - improved sustainability and long term productivity. Silvopasture increases biological activity, protects water quality, and reduces soil erosion. As a result, water holding capacity of the soil is increased.
3. Wildlife habitat – the structure and plant diversity is attractive to wildlife species including wild turkey and deer.
4. Insect control – with the application of proper forestry practices bark beetle populations are reduced and/or controlled. Beetle movement is hampered by lower tree density and the distance between trees.
5. Reduced risk of wildfire – silvopastures have lower tree density and less understory fuel load than a traditional tree plantation.

Cautions with Silvopasture

1. The silvopasture system requires intensive management to reap its full benefits. If this is not possible, silvopasture should not be considered.
2. Like traditional open pastures, overgrazing and animal overstocking can damage trees and forage resources.
3. Land will need to be taken from livestock production to avoid damage to newly planted and young trees.

Considerations

There are several factors to consider before beginning a silvopasture system.

1. Silvopasture is a long term commitment. Timber rotations can last 30 years or longer.
2. Site preparation, including clearing the site, to establish trees and or forage grasses
    a. Pasture conversion to silvopasture versus conversion of existing timber to silvopasture; both require different strategies, amounts of labor, and expense.
3. Tree seedling costs
4. Seeding cost for forage species
5. Fencing to control and move livestock
6. Establishing firebreaks (if prescribed burning is a management component)
7. Livestock watering facilities

Components of Silvopasture

There are three main components of silvopasture:

Trees

Trees provide the large, long term economic return in the silvopasture systems, but they also provide shelter and shade for livestock. The shade reduces heat stress to livestock and increases animal grazing time when compared to open or sparsely shaded pastures. Trees provide better ventilation and evapotranspiration than barns or temporary structures. Shade also reduces the amount of solar energy reaching the ground which creates lower surface soil temperatures and reduces the amount of water lost to evaporation. Soil temperatures at the East Texas Plant Materials Center were measured in July of 2015. Bare, fallow ground gave a reading of 110^{o} F at approximately 4 inches while soil temperatures in

the forest and fields containing cover crops ranged from 78 to 90° F. When combined, these factors have to the potential to translate into better forage and livestock production.

Within the southeastern United States, pine trees (loblolly (*Pinus taeda*), slash (*Pinus elliottii*), and longleaf (*Pinus palustris*)) are favored for silvopasture. They are marketable species with several different commercial uses. Slash pine is especially suited because of its open crown and good self-pruning ability. Hardwoods, such as pecan, hickory, or walnut can be used in silvopasture for nut and (or) timber production. However, they are slower to establish and have a longer rotation time.

Choose trees that:

- Are compatible with the site
- Meet landowner/manager objectives
- High value product
- Open crowned to allow light penetration producing a light shade
- Deep rooted to avoid competing with forage plants

Forages

An assortment of grasses, legumes, and forbs can be used for the forage mixture. Use both warm and cool season species to lengthen the grazing season and improve winter forage quality. Warm season grasses include big bluestem, little bluestem, switchgrass, indiangrass, eastern gamagrass, bermudagrass (introduced), and bahiagrass (introduced). Cool season grasses include Canada wildrye, Virginia wildrye, cereal rye, annual rye, wheat, triticale, and oats. One recommendation is to plant about 1 acre warm season grass for every 2.5 to 3 acres of cool season grass (USDA-National Agroforestry Center 2008a). This recommendation is based upon geographic location. In the western coastal plain, warm season forage may make up a greater portion of the grazing system. At the end of this technical note is a reference table (see Table 1) listing assorted native and introduced warm season and cool season forage species with their seeding dates and rates. To reduce fertilizer costs, include cool season nitrogen fixing legumes such as crimson or red clover as an N source for the grasses.

Choose forages that:

- Are compatible with the site
- Suited to livestock grazing
- Productive in partial shade
- Tolerant of heavy grazing
- Are beneficial for wildlife - if that is one of the end uses of the property

Livestock

Through grazing, livestock control weeds and plant competition. Currently the main livestock species for silvopasture are cattle, goats, and sheep with cattle the most popular. Use cattle breeds that tolerate heat well. Cattle with light colored, sleek, shiny coats are able to tolerate warmer temperatures better than animals with denser, wooly, darker coats. The sleek, shiny coats reflect more incident solar radiation and allow the cattle to sweat efficiently (Williams, Finch 1985). Other potential animals for silvopasture include horses, turkey, and chickens.

Choose livestock that:

- Meet land manager objectives
- Are suited to a silvopasture environment
- Adapted to the established forage mixture

- Adapted to the local climate

Design and Establishment

Silvopastures can be created by planting trees into open pastures or thinning stands of trees and planting forages. Planting trees into an existing pasture requires less labor and financial inputs than converting existing timber stands to silvopasture. Normally, the recommended planting rate for silvopasture is between 100 to 400 trees/acre. Trees need to have at least one side in full sun for proper growth. Therefore, trees planted in single or double rows are generally preferred over triple or multiple row arrangements. Tree spacing within the row is also important and varies from 6 to 10 feet. A wider width between tree alleyways (along with periodic thinning) helps to sustain forage productivity as the tree canopy or basal area increases. Common alleyway widths are 15, 20, 30, or 40 feet. Alleyways between tree rows should be wide enough for haying and fertilizing equipment. Trees don't **have** to be planted in rows, but farming operations and maintenance are easier to complete when trees are not planted in a scattered pattern.

Continuous grazing is not recommended in silvopasture systems because of detrimental effects to the soil and forage resources. Design rotational grazing paddocks to facilitate livestock movement, have similar grazing capacities, and watering facilities.

For detailed information concerning design and establishment, refer to NRCS Conservation Practice Standard Silvopasture Establishment – Code 381, Conservation Practice Job Sheet Silvopasture Establishment 381 (Texas), and the USDA National Agroforestry Center publication Silvopasture: Establishment and management principles for pine forests in the southeastern United States, J. Hamilton (ed).

Management Considerations

In silvopasture, all three components are managed as a single unit.

Trees

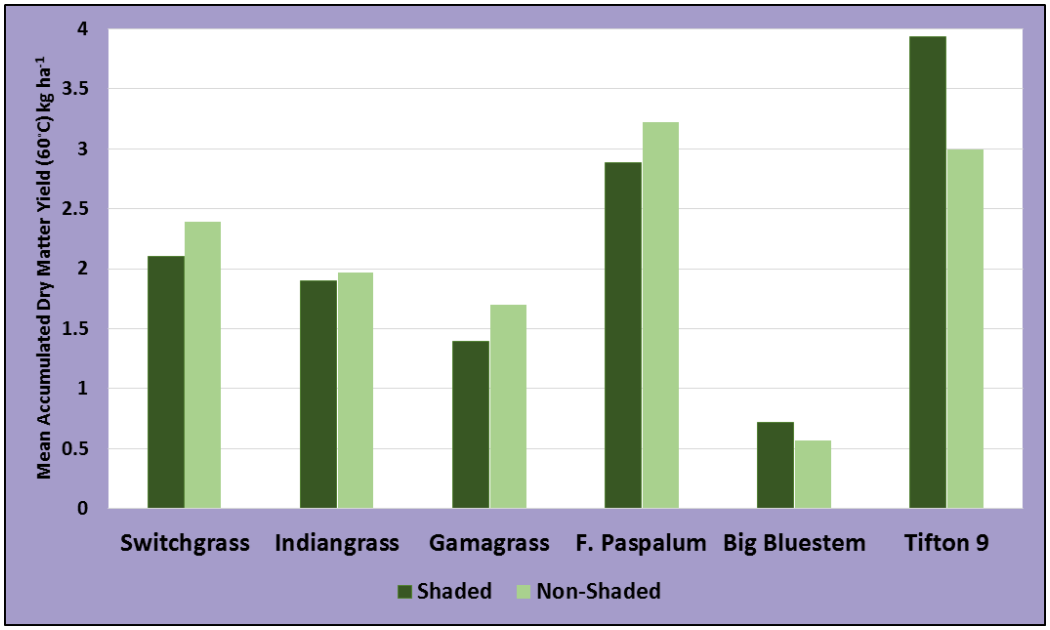
The goal of timber management in silvopasture is to produce marketable saw logs. Therefore, proper forestry practices including winter pruning and thinning are required. Pruning removes larger side branches that reduce wood quality and allows farm equipment to travel close to the tree rows. Thinning is the harvesting of smaller or diseased trees. This practice enhances forest health by allowing the remaining trees to use more of the available nutrients and water for growth. Thinning can increase forage production and allow more sunlight to penetrate the forest floor. Weed control reduces the nutrient and water competition for younger trees. Control measures include herbicide, mulches, and mechanical control. Weed control should be maintained for at least 3 to 5 years after planting.

Forages

One of the goals of silvopasture management is to sustain forage production during the majority of the tree rotation by controlling canopy density (by thinning and pruning) and forage fertilization. Canopy density in silvopasture is usually managed for 25 to 45 percent for warm season grasses and 40 to 60 percent for cool season grasses. Depending upon site productivity, thinning intervals would be every 5 to 7 years. Forages growing under trees in a shady environment tend to mature slower, have lower fiber, are more digestible, and show increased protein and phosphorus concentrations compared to open areas.

In a three year study conducted at the East Texas Plant Materials Center, five native warm season grasses ('Harrison' Florida paspalum, 'Alamo' switchgrass, 'Kaw' big bluestem, 'Nacogdoches' eastern gamagrass, and indiangrass) and two introduced grasses ('Tifton 9' bahiagrass and 'Tifton 85' bermudagrass were evaluated for yield and forage quality. The grasses were grown in the open (no shade) and 50% shade to simulate a silvopasture environment. There was a decline in forage yield under shade, but the decrease in production was minimal compared to no shade yields. Shade also improved forage quality of both native and introduced forages (Hill et al. 2014). Below is a chart (Figure 1) showing the study yields in the open and shaded environments.

Figure 1. Yield of six forages in a shaded and non-shaded environment.
(USDA-NRCS East Texas Plant Materials Center, Nacogdoches, Texas).



Forages are fertilized by using nitrogen produced by legumes, livestock manures, and (or) commercial fertilizer. In a Georgia study, researchers replaced commercial N sources with crimson clover and found that forage yield and quality were improved in a young longleaf pine bahiagrass silvopasture used for hay (Karki et al 2009).

Rotational grazing is another management component to sustain pasture viability. By allowing grazing animals only a certain time period in a paddock, soil compaction is reduced and trees are protected from over browsing. This practice also allows recovery periods for forage plants after grazing. For example, native warm season grasses like eastern gamagrass (*Tripsacum dactyloides*) should be only be grazed down to an 8-10 inch stubble height. Habitual grazing below that height depletes carbohydrate reserves and results in reduced forage productivity. Perennial grasses also need enough time at the end of the growing season to store carbohydrates for regrowth the following spring.

Toxic weeds and trees should be controlled. Trees toxic to livestock include black cherry, black locust, black and red oak. Inspect pastures and paddocks on a regular basis. Control these weeds/trees by mowing, removing, or herbicide applications. Even though, older, more experienced animals may avoid these weeds, younger animals may not. Symptoms of poisoning can vary from trembling and sweating to toxic milk, heart failure and sudden death. At the end of this technical note is a reference

table (see Table 2) listing some common weeds toxic to livestock. This list is not all inclusive and may vary by geographic region.

Livestock

Livestock should be excluded from areas with newly planted trees. They damage trees by eating, trampling, or rubbing off the bark or breaking the trunk. These excluded areas could be used for hay production during initial tree establishment. Introduce livestock to a silvopasture when the top branches of planted trees have grown beyond their grazing reach and a thick layer of bark has developed. An alternative to excluding livestock is to use electric fence to keep animals away or tree sleeves for protection. Even after the trees are established, livestock can damage conifers by over browsing when the trees begin new spring growth.

Livestock need access to a reliable water source for each paddock. Grazing animals consume more water and efficiently utilize pasture when the travel distance is less than 800 feet. Plan for one water source to serve multiple paddocks, if watering facilities are limited.

Summary

- Silvopasture is a “hands on” balanced, integrative, and intensive approach to the management of trees, forage, and livestock. All three components are managed as one unit to optimize income opportunities from the same piece of land.
- When conducted correctly, this system is sustainable while offering the following benefits:

Livestock forage	Reduced soil erosion
Forestry products	Enhanced wildlife habitat
Improved water quality	Reduced fire hazard

Table 1 – Seeding Rates and Dates of Assorted Native and Introduced Warm and Cool Season Forage Species*

Common Name	Scientific Name	Variety	Seeding Rate (PLS lb./ac.)	Seeding Date (Prepared seedbed or no till)	Remarks
Big bluestem	*Andropogon gerardii*	Kaw, Earl, local harvest	6	2/15-5/1 3/1-5/15	Best adapted to deep loamy fertile upland sites receiving at least 25" rainfall annually.
Little bluestem	*Schizachryium scoparium*	Aldous, Cimarron, native mix	3.4	2/15-5/1 3/1-5/15	Aldous and Cimarron are best adapted to all upland soils in the claypan and southern blackland areas of Texas.
Switchgrass	*Panicum virgatum*	Alamo	2	2/15-5/1 3/1-5/15	Adapted to most soils in areas of Texas receiving at least 25" precipitation annually.
Indiangrass	*Sorghastrum nutans*	Lometa	4.5	2/15-5/1 3/1-5/15	Adapted to soils from sands to clays in areas of Texas that receive at least 22" annual precipitation. Best adapted to loamy soils.
Eastern gamagrass	*Tripsacum dactyloides*	Nacogdoches	10	11/15-1/15 (Not stratified) 2/15-5/15 (Stratified)	Adapted to most soils in areas of Texas that receive more than 25" annual rainfall. Not recommended on deep or very deep sandy soils.
Florida paspalum	*Paspalum floridanum*	Harrison germplasm	8	12/1-6/1	Quail, dove, and turkey eat Florida paspalum seed. Plant no deeper than ½".
Hybrid bermudagrass	*Cynodon dactylon*	Coastal	12-20 bu./ac. (Sprigging) 24-40 bu./ac. (Broadcast)	1/15-6/1 8/15-9/30	Best adapted to moderately to well drained sandy to loamy soils, but will persist on clayey soils.
Hybrid bermudagrass	*Cynodon dactylon*	Tifton 85	12-20 bu./ac. (Sprigging) 24-40 bu./ac. (Broadcast)	1/15-6/1 8/15-9/30	Soil adaptation similar to Coastal, but slightly less cold tolerant. Higher production potential, and better forage quality than Coastal.
Bahiagrass	*Paspalum notatum*	Pensacola, Tifton 9	12-15	10/1-6/1	Best adapted to the high rainfall areas of East Texas and Coast Prairie. Adapted to a wide variety of soils with pH of 5.5 to 7.0.
Canada wildrye	*Elymus canadensis*	Lavaca select germplasm, common, local ecotype	12	9/1-10/15	Best suited to uplands.

Table 1 (cont'd)					
Common Name	**Scientific Name**	**Variety**	**Seeding Rate (PLS lb./ac.)**	**Seeding Date (Prepared seedbed or no till)**	**Remarks**
Virginia wildrye	*Elymus virginicus*	Omaha, Kinchaffoonee germplasm, common, local ecotype	12	9/1-10/15	Best suited to bottomlands.
Cereal rye	*Secale cereal*		56 -120	9/1-10/15 9/15-11/30 (Overseeded)	Most drought resistant and cold tolerant of the cool season annuals. Prefers well drained sandy to loamy soils.
Annual rye	*Lolium multiflorum*		12 - 30	9/1-10/15 9/15-11/30 (Overseeded)	Best adapted to areas of Texas receiving more than 25" annual rainfall. Adapted to a wide range of soils. With adequate rainfall usually the most productive of the cool season annual grasses, but most production will be in spring.
Winter wheat	*Triticum aestivum*		60 - 120	9/1-10/15 9/15-11/30 (Overseeded)	Good cold and drought tolerance. Good fall and winter production. Least productive of the cool season forages.
Triticale	*X Triticosecale*		50 - 120	9/1 – 10/15 9/15 – 11/30 (Overseeded)	Cross between wheat and rye. Usually yields less than rye, oats, and ryegrass.
Oats	*Avena sativa*		64 - 120	9/1-/10/15 9/15-11/30 (Overseeded)	Early fall grazing, ability to germinate in low moisture. Limited winter forage, usually planted in a mix. Adapted to deep loam and sandy loams. Usually not planted in NE Texas due to lack of cold tolerance.
Crimson clover	*Trifolium incarnatum*	Dixie, Tibbee, Flame, Chief	15-20	9/15-11/30	Adapted to most soils with pH of 6.0-7.0. Early maturity, medium bloat potential, good cold tolerance.
Red clover	*Trifolium pratense*	Kenland, Cherokee	10-12	9/15-11/30	Adapted to loamy and clayey soils with pH of 6.5 -8.0 and good drainage. Late maturity, low bloat potential, good cold tolerance.
Berseem clover	*Trifolium alexandrinum*	Bigbee	12 -15	9/15-11/30	Adapted to loamy to clayey soils with pH of 6.5 -8.0 and fair/poor drainage. Late maturity, low bloat potential, poor cold tolerance.
Ball clover	*Trifolium nigrescens*	Common, local harvest	2 - 4	9/15 – 11/30	Adapted to loamy to clayey soils with pH of 5.5 – 8.0 and fair drainage. Late maturity, low bloat potential, good cold tolerance.
Arrowleaf clover	*Trifolium vesiculosum*	Apache, Meechee, Yuchi, Amclo	8 -10	9/15 – 11/30	Adapted to sandy to loamy soils with pH 5.5 – 7.0 and good drainage. Late maturity, low bloat potential, good cold tolerance. Apache developed in TX.

*Table information comes from NRCS Texas Field Office Technical Guide Appendix 1-Planting rates for seeding and sprigging in Texas, Zone 4 (October 2014).

Table 2 – Common Weeds Toxic to Livestock**

Common Name	Scientific Name	Flower Color	Remarks
Bitter sneezeweed	*Helenium amarum*	yellow	Dangerous-leaves, stems, flowers and fruit are poisonous
Black nightshade	*Solanum americanum*	White or light purple	Dangerous –leaves and unripe berries are poisonous to livestock and pets
Bracken fern	*Pteridium aquilinum*	Green foliage	Dangerous-triangular fronds with multiple stems
Coffee senna	*Cassia occidentalis*	yellow	Affects cattle in particular
Common cocklebur	*Xanthium strumarium*		Dangerous – seeds and seedlings
Crotalaria or showy rattlebox	*Crotalaria spectabilis*	yellow	Dangerous-leaves, stems, roots, and seeds are poisonous
Cress leaf groundsel or butterweed	*Packera glabella*	yellow	Seed, flowers and leaves. Plants maintain toxicity after drying, still toxic in baled hay.
Golden ragwort	*Packera aurea*	yellow	Seed, flowers, and leaves. Young plants more toxic than older ones. Plants maintain toxicity after drying, still toxic in baled hay.
Hemp dogbane	*Apocynum cannabinum*		Leaves are very toxic. The leaves and stem have a milky sap when broken.
Hemp sesbania	*Sesbania herbacea*	Yellow may have purple streaks	Dangerous- seeds
Horsenettle	*Solanum carolinense*	White or purple	Berries and leaves are poisonous
Jimsonweed or locoweeds	*Datura stramonium*	white	All parts and seeds of plant are poisonous.
Mustards	*Brassica*	yellow	All parts are toxic.
Partridge pea	*Chamaecrista fasciculata*	yellow	Potentially dangerous to cattle.
Perilla mint or beefsteakplant	*Perilla frutescens*		Leaves and stems can be dangerous. Plant emits a mint odor.
Pokeweed	*Phytolacca americana*		Dangerous –roots, shoots, leaves, and berries.
Sicklepod	*Cassia obtusifolia*		Weakly toxic but can still effect livestock.
Smooth pigweed or slim amaranth	*Amaranthus hybridus*	green	All parts of this plant are poisonous.
White snakeroot	*Ageratina altissima*	white	All parts of this plant are poisonous. Toxin can be passed along in milk.
Dwarf larkspur	*Delphinium tricorne*	purple	All parts of plant are very toxic, even in baled hay.
Sundial lupine	*Lupinus perennis*	Blue, pink, or white	All parts are toxic, especially pods with seeds.
Horsetail	*Equisetum* spp.		Generally found in wetter portions of a field. All parts are toxic when dried.
Common milkweed	*Asclepias syriaca*	Pink, purple, orange, white	Stems, leaves, and roots are toxic.

Table 2 (cont'd)			
Common Name	**Scientific Name**	**Flower Color**	**Remarks**
Poison hemlock	*Conium maculatum*	white	All parts are toxic, especially young plants.
Bouncingbet or soapwort	*Saponaria officinalis*	White, pink or red	Leaves and stems. Forms toxic substance, saponin, when mixed with water.
Johnsongrass	*Sorghum halepense*		Leaves and stems possess cyanide. Most toxic when wilted or frost damaged.
Ohio buckeye	*Aesculus glabra*	yellow	Buds, nuts, leaves, bark, seedling and honey contain aesculin.
Snow on the mountain	*Euphorbia marginata*	white	All parts of plant are poisonous.
Water hemlock	*Cicuta* spp.	white	All parts of plant, especially roots are poisonous.
Wild indigo	*Baptisia* spp.	Flower color varies depending on species	All parts are poisonous.
Wooly croton or goatweed	*Croton capitatus*		All parts of plant are poisonous. Cattle are effected by the croton oil in the plants.
*This list is not all inclusive.			

**Table information comes from "Identifying common poisonous pasture weeds" by Southern States Cooperative, Guide to Toxic Plants in Forages (bulletin WS-37) (Purdue University Extension), and Plants Poisonous to Livestock (bulletin G4970) (University of Missouri Extension).

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