



Silvopasture: Integrating Trees, Forages and Livestock

What is Silvopasture?

Silvopasture is an agroforestry practice that is specifically designed and managed for the production of trees, tree products, forage and livestock. Silvopasture results when forage crops are deliberately introduced or enhanced in a timber production system, or timber crops are deliberately introduced or enhanced in a forage production system. As a silvopasture practice, timber and pasture are managed as an integrated managed grazing system. **Silvopasture is *not* the indiscriminate grazing of forestland.**

Silvopastoral systems are designed to produce a high-value timber component or alternative forest product, while simultaneously providing short-term cash flow from the livestock component.

Overall, silvopastures can provide cost-effective economic returns while creating a sustainable system with many environmental benefits. Well-managed silvopastures also offer diversified marketing opportunities that can help stimulate rural economic development.



Planning Considerations

Before a new silvopasture practice is established, implications of merging forestry and livestock systems should be explored thoroughly for economic and environmental considerations. In addition, local land use, zoning, cost-share programs and tax regulations should be investigated. Forest and agricultural land may have separate zoning and land-use regulations accompanied by divergent tax assessments. Environmental requirements (e.g., planting trees, stream-side protection, and wildlife habitat maintenance) may also vary with land use.

Plants

When making tree and forage crop selections, consider potential markets, soil types, climatic conditions, equipment needs, and species compatibility. On marginally productive lands, some conifer species are well-suited for silvopastures because they can adapt to diverse growing sites, respond rapidly to intensive management and may permit more light to reach the forest floor compared to certain hardwood species. However, native or adapted conifers that would be suited to Illinois conditions are somewhat limited and should be assessed on the individual site basis and also provide a suitable tree crop for the intended market. Select and use trees and planting/harvesting patterns that are suitable for the site, compatible with planned practices and provide desired economic returns and ecosystem services. Clovers or other pasture legumes are often seeded into grass pastures to provide highly nutritious forage for livestock and to convert atmospheric nitrogen into an organic form which plants and animals can use. Competition between trees and pasture is reduced by selecting pasture plants with non-competing growth cycles to trees or are shallower rooted. For example, cool season

grasses (such as orchardgrass or timothy) and legumes (such as ladino or red clover) can be seeded into pine stands with little detrimental impact upon growth of either trees or pasture plants.

Trees in pasture provide shelter for livestock during periods of inclement weather. This can significantly improve animal performance during particularly hot or cold times of the year. Trees provide evaporative cooling, reduce radiant heat loss at night, and reduce wind speed. These buffered environmental conditions allow animals to spare energy for growth, particularly under hot conditions. Increased gain, milk yield, and conception rates have been reported for cattle or sheep grazing pastures with trees in warm environments. The tree/timber component should be capable of providing the desired products and be:

- marketable,
- fast growing,
- non-toxic to intended livestock,
- non-invasive,
- native (if possible) and
- compatible with the site (soil, temperature, precipitation, planted forages).

Forage growing under the shady, low wind environment near trees tends to mature more slowly and, therefore, be lower in fiber and more digestible than that growing out in the open. The forage component should be a perennial crop that is:

- suitable for livestock grazing,
- compatible with the site (soil, temperature, precipitation, planted trees),
- productive under partial shade and moisture stress, and
- responsive to intensive grazing management.



Species Selection for Trees

Tree species should be suited to the site and growing conditions, meet the desired objectives of the system and be tolerant and safe for the livestock used. Native trees should be favored wherever possible. The following table is an abbreviated list of suitable tree species.

Table 1. Examples of trees suitable for use in silvopasture

Uplands			
Bur oak	<i>Quercus macrocarpa</i>	Sugar maple	<i>Acer saccharum</i>
Red oak	<i>Quercus rubra</i>	Shagbark hickory	<i>Carya ovata</i>
White oak	<i>Quercus alba</i>	Pecan	<i>Carya illinoensis</i>
Black walnut	<i>Juglans nigra</i>	Persimmon	<i>Diospyros virginiana</i>
Pine species	<i>Pinus spp.</i>	Chinkapin oak	<i>Quercus muehlenbergii</i>
Bottomlands			
Persimmon	<i>Diospyros virginiana</i>	Black walnut	<i>Juglans nigra</i>
Silver maple	<i>Acer saccharinum</i>	Pecan	<i>Carya illinoensis</i>
Swamp white oak	<i>Quercus bicolor</i>	Bur oak	<i>Quercus macrocarpa</i>
Kentucky Coffeetree	<i>Gymnocladus dioicus</i>	Shellbark hickory	<i>Carya laciniosa</i>

Tree Planting Stock

Tree planting stock should be at least 1-3 feet tall with at least 3/8-inch caliper. The large initial size is required to facilitate their protection from fire, reduce competition from grass, and damage from livestock. Seedlings may be planted by hand or machine. Newly planted seedlings should be protected (barrier fence) until their height growth is above the browse reach of livestock. Utilize conservation practice standard TREE/SHRUB ESTABLISHMENT (Practice Code – 612).

Tree Establishment

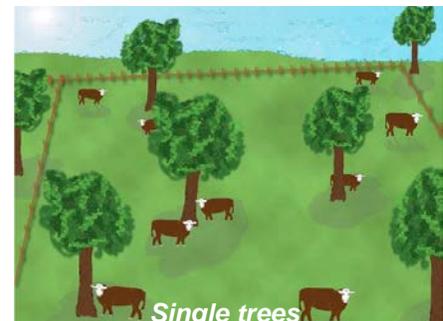
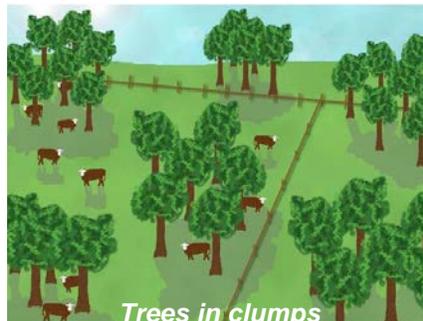
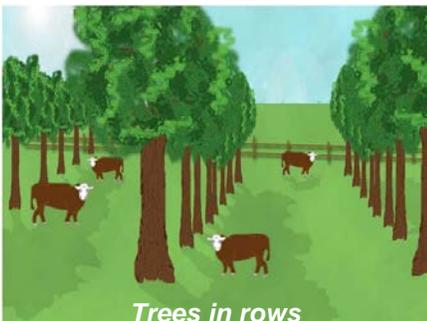
Tree establishment in existing grass fields can be difficult. Items to consider for tree establishment include:

- Site preparation – On sites that have been in pasture and are subject to compaction ripping the soil surface down or adjacent to the planted tree rows before planting will improve growth and survival.
- Weed control – At a minimum, a vegetation free area at least 2 feet in all directions from the tree should be controlled for 2 to 3 years after planting.
- Number of trees – Pine is usually planted at a rate of 200 to 400 trees per acre and hardwoods are generally planted at a rate of 100 to 300 trees per acre. (28 - 48 for container trees >1 gallon)
- Protection – Protect the trees from grazing during establishment utilizing protective measures such as fencing or by utilizing the field for hay until the trees are tall enough and strong enough to withstand grazing pressure.
- Utilize conservation practice standards TREE/SHRUB SITE PREPERATION (Practice Code – 490) and TREE/SHRUB ESTABLISHMENT (Practice Code – 612).

Tree Layout & Spacing

Spacing distance between woody plants and row sets should be based on landowner objectives, tree and shrub environmental requirements, light requirements and growth periods of the forage, and machinery requirements.

Plant trees in single, double or triple row-sets; cluster plantings may also be used. When multiple row woody plant sets are used, stagger within row tree spacing with adjacent row to maximize growing space.



Existing Forestland

High quality undisturbed forest sites are not best suited for silvopasture, more value is realized by maintaining a well-managed forest condition. Existing forest sites in Illinois that can be suited to silvopasture systems are those currently being grazed where rotational grazing will improve the conservation benefits for the trees and livestock and/or existing plantations dominated by black walnut, pecan and pine. For existing forest plantations/stands, reduce stocking levels to at least a 50% (allow 50% sunlight to reach establishing forage) stocking level for the normal stand or adjust the canopy density to accommodate the needs of the forage species. Trees should be as uniformly spaced as possible for even shade distribution. Utilize the assistance of a professional forester to identify opportunities to reduce stocking in order to maintain a desirable residual stand to achieve desired forestry goals.

Species Selection for Grass/Legumes

Grasses and legumes should be favored that are tolerant of partial shade and moisture stress, and responsive to intensive grazing management. Suggested examples of possible grasses and legumes for silvopasture use are listed in Table 2. Utilize conservation practice standards FORAGE AND BIOMASS PLANTING (Practice Code – 512) for species selection, establishment and management.

Table 2. Examples of grasses and legumes suitable for use in silvopasture

Grasses			
Native			
Big bluestem	<i>Andropogon gerardii</i>	Canada wildrye	<i>Elymus canadensis</i>
Little bluestem	<i>Schizachyrium scoparium</i>	Eastern gamagrass	<i>Tripsacum dactyloides</i>
Switchgrass	<i>Panicum virgatum</i>	Virginia wildrye	<i>Elymus virginicus</i>
Indiangrass	<i>Sorghastrum nutans</i>		
Introduced			
Novel endophyte fescue	<i>Festuca spp.</i>	Orchardgrass	<i>Dactylis glomerata</i>
Kentucky bluegrass	<i>Poa pratensis</i>	Timothy	<i>Phleum pratense</i>
Smooth brome	<i>Bromus inermis</i>	Ryegrass	<i>Lolium perenne</i>
Legumes:			
Native			
White prairie clover	<i>Petalostemon candidum</i>	Roundhead lespedeza	<i>Lespedeza capitata</i>
Leadplant	<i>Amorpha canescens</i>	Showy tick trefoil	<i>Desmodium canadense</i>
Introduced			
Annual lespedeza	<i>Kummerowia striata</i>	White clover	<i>Trifolium repens</i>
Alfalfa	<i>Medicago sativa</i>	Red clover	<i>Trifolium pratense</i>
Birdsfoot trefoil	<i>Lotus corniculatus</i>		



Livestock

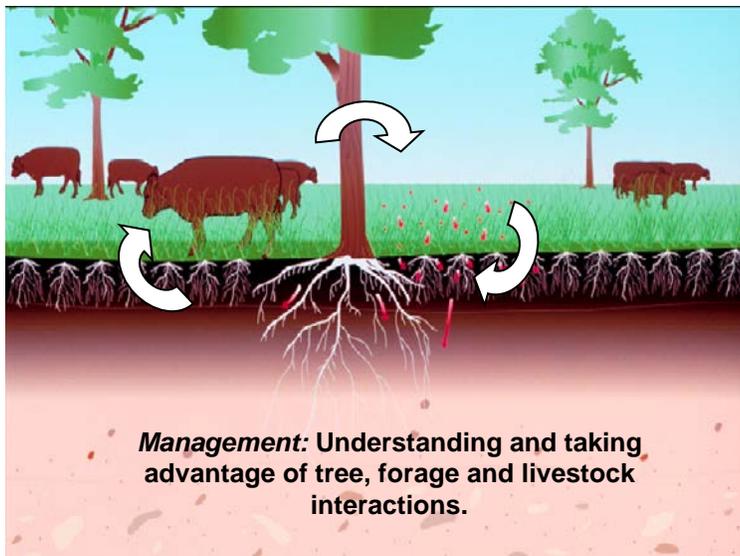
Potential livestock choices include cattle, sheep, goats, horses, or large game animals such as bison, deer, and elk. The selected livestock system must be compatible with tree, forage, and environmental requirements. In general, browsing animals such as sheep, goats or deer are more likely to eat trees; whereas, large grazing animals such as cattle or elk are more likely to physically break young trees. Younger livestock are more prone to damage trees than older, more experienced animals. Livestock activity is more likely to impact hardwood trees than conifers. Silvopasture establishment within existing forestland in Illinois will be in conjunction with a management intensive rotational grazing system. The appropriate rotational grazing system will be designed to include multiple paddocks, short grazing intervals and appropriate rest periods for forage regrowth. Carrying capacities and grazing intervals will be designed based on the type of livestock being grazed, forage being produced and trees being used in order to optimize tree health and production. Conifers, although not really palatable to livestock, are most likely to be browsed after spring bud break when foliage is still light green in color. Livestock prefer variety in their diet. They will often consume a small amount of tree foliage each day. This small amount of browsing may accumulate to unacceptable levels when animals are in the silvopasture for prolonged periods. Browsing damage can sometimes be eliminated by removing a few problem animals. Trampling of seedlings and livestock rubbing on tree saplings may be a problem, particularly with cattle. Where livestock damage must be avoided, young silvopastures may be hayed, or trees protected from



Clean, well placed water is critical to a silvopasture system.

livestock by chemical repellents, electric fences, individual tree shelters or rigid mesh tubes. Once the top branches of trees grow above the reach of livestock and a thick layer of bark has developed, potential for tree damage by livestock browsing is minimal and silvopastures may be managed similar to traditional pastures. Utilize conservation practice standards PRESCRIBED GRAZING (Practice Code – 528) for managing forage and livestock.

Management



At a minimum, a vegetation free area at least 2 feet in all directions from the tree should be controlled for 2 to 3 years after planting. Young trees will benefit from vegetation control after planting. Herbaceous plants and many brush species may be effectively suppressed by prescription grazing, mechanical treatment or chemical application. A commonly used approach when planting trees into established pastures is to spray a strip or circle around trees to provide a two to four foot diameter competition-free zone around each tree.

Livestock grazing must be intensively managed. Silvopasture establishment in

Illinois will be in conjunction with a management intensive rotational grazing system. A successful silvopasture requires understanding forage growth characteristics and managing the timing and duration of grazing to avoid compaction, root and bark damage, overgrazing of forage and browsing of young tree seedlings or elongating shoots.

Some things to consider when setting up a silvopasture system include the following items:

- Keep livestock within 800 feet of water
- Make paddocks as near to square as possible
- Follow landscape lines for paddock boundaries
- Make paddocks of similar grazing capacity
- Plan lanes for livestock movement
- Identify and control poisonous plants
- Practice rotational grazing and follow conservation practice standard PRESCRIBED GRAZING (Practice Code – 528).

Livestock should be excluded from tree plantings during vulnerable periods. Similar approaches can minimize damage by trampling or rubbing. Improper management of silvopastures can reduce desirable woody and herbaceous plants by over-grazing and soil compaction. When introducing livestock to newly-established silvopastures: 1) have plenty of feed on hand; 2) provide water, minerals, and supplements away from new trees; and 3) be willing to accept some seedling damage. Thus, proper management is the key to success when implementing silvopastoral systems.

Available management tools include:

- tree harvesting, thinning and pruning
- fertilization to improve both forage and tree production
- planting legumes for nitrogen fixation and forage production
- multi-pasture, rotational grazing
- rotational prescribed fire

- supplemental feeding
- water source infrastructure (e.g., stock tanks, photovoltaic pumps, hydraulic rams, etc.)
- locating salt/mineral licks and walkways to encourage uniform livestock distribution
- fencing (e.g., standard or electric), tubing, plastic mesh, repellents, and seasonal livestock exclusion to reduce damage to young seedlings



Hardwood silvopasture system developed from an existing forest stand.



Conifer silvopasture system developed from an existing grass pasture.

References

The following references have been used in the development of this information sheet.

Adapted from MO NRCS 381 - Information Sheet 2005: Silvopasture Establishment and Management (IS-MO381)

Fike, J. H., Buergler, A. L., Burger, J. A., and Kallenbach, R. L. 2004. Considerations for establishing and managing silvopastures. Online. Forage and Grazinglands.

Garrett, H. E., Kerley, M. S., Ladyman, K. P., Walter, W. D., Godsey, L. D., and Van Sambeek, J. W. 2004. Hardwood silvopasture management in North America. *Agroforestry Systems* 61: 21-33.

Lin C. H., McGraw, R. I., George, M. F., and Garrett, H. E. 1999. Shade effects on forage crops with potential in temperate agroforestry. *Agroforestry Systems* 44:109-119.

“Silvopasture: An Agroforestry Practice”. 1997. *Agroforestry Notes*. National Agroforestry Center. AF Note-8.

“The Biology of Silvopastoralism”. 1997. *Agroforestry Notes*. National Agroforestry Center. AF Note-9.

“Agroforestry in the United States”. 1996. *Agroforestry Notes*. National Agroforestry Center. AF Note-1.

For additional information on silvopasture, contact your local USDA Service Center.

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