USDA National Agroforestry Center
AGROFORESTRY NOTES
AF Note — 22
December 2000

From A Pasture to A Silvopasture System

There is potential to diversify a grazing operation and improve economic or environmental benefits on many acres through conversion of pasture to silvopasture. Silvopasture is the integration of trees with livestock grazing and forage operations. Research has demonstrated that, if managed properly, forage production can be maintained while producing high value timber.

Considerations

Southern pines (loblolly, longleaf, and slash) have been found to be compatible with forage production and livestock grazing when properly managed. This technical note provides several options for establishment of southern pines in existing pasture systems for the production and management of both forest and forage products. The following are planning considerations to convert from pasture to silvopasture:

Soils

Determine the soil suitability of the area for establishing pine trees. If the soil is not suited to southern pine species do not convert to a pine silvopasture system.

Tree Planting

Determine the desired row spacing for the pine planting. Planting rates from 100 to 400 trees per acre are typically recommended for planting a silvopasture system. Trees may be grown in single rows or in aggregate rows called sets with wide alleys for for-

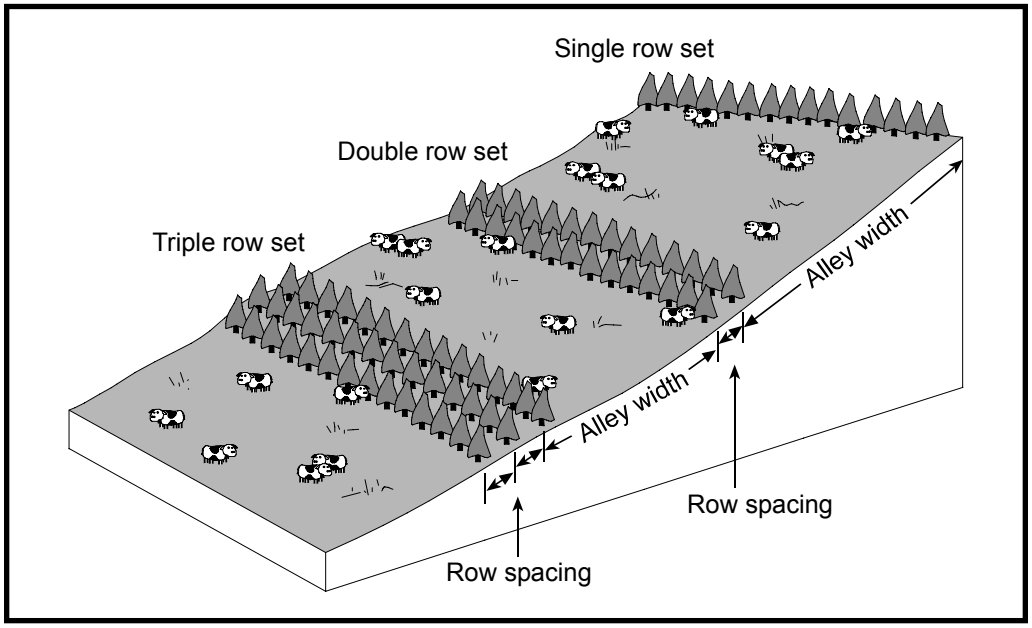

Figure 1: Typical layout diagram showing alley width, row spacing, and tree sets for establishing a silvopasture system in existing pasture.

Table 1: Silvopasture Planting Options and Trees Per Acre *

	Single-Row Set				Double-Row Set				Triple-Row Set			
		Tree-to-tree-in-row spac-				Tree-to-tree-in-row spac-				Tree-to-tree-in-row spac-		
Alley Width	Row Spacing	6 foot	8 foot	10 foot	Row Spacing	6 foot	8 foot	10 foot	Row Spacing	6 foot	8 foot	10 foot
15 feet	Row spacing and alley width are the same for single-row sets.	484	363	290	6 foot	**691**	**518**	**414**	6 foot	**807**	**607**	**484**
					8 foot	**631**	**473**	378	8 foot	**703**	**528**	**422**
					10 foot	**580**	**435**	348	10 foot	**622**	**468**	374
					12 foot	**537**	**403**	322	12 foot	**558**	**418**	335
20 feet		363	272	218	6 foot	**558**	**418**	335	6 foot	**680**	**512**	**409**
					8 foot	**518**	388	311	8 foot	**605**	**455**	363
					10 foot	**484**	363	290	10 foot	**545**	**409**	327
					12 foot	**454**	340	272	12 foot	**495**	372	297
30 feet		242	182	145	6 foot	**403**	303	242	6 foot	**512**	390	311
					8 foot	382	287	229	8 foot	**473**	356	284
					10 foot	363	272	218	10 foot	**435**	328	262
					12 foot	345	259	207	12 foot	**403**	303	242
40 feet		182	136	109	6 foot	315	237	189	6 foot	**419**	315	252
					8 foot	303	227	182	8 foot	389	292	234
					10 foot	290	218	174	10 foot	363	273	218
					12 foot	279	209	167	12 foot	340	256	204

Bold figures are outside of recommended planting rates for silvopasture
***Field shape and planting design may cause some variation in trees-per-acre.**

age production between sets. (See figure 1) Examples of recommended planting options are shown in table 1.

Planting arrangement should consider management objectives, equipment operability, adequate growing space until the first tree harvest, and companion-forage species needs.

The desired establishment density, in part, is determined by the existing markets for timber products. Higher planting densities will require the removal of smaller-diameter trees to prevent canopy closure. If readily available markets for small round wood exist then the higher planting densities are feasible options. If, however, these markets don't exist, the lower planting densities have the advantage of reducing the need for non-commercial thinning.

On sloping land, rows should be oriented on the contour to prevent soil erosion within the tree rows during establishment.

Site Preparation and Establishment

Determine site preparation needs. Apply a herbicide or till a strip two to four feet wide for each row to be planted. If the soil has a compacted layer, rip or subsoil down the planting rows. This improves the ease of planting and improves rooting conditions for young seedlings, thus ensuring better survival and growth. In some areas, a prescribed burn or pesticide treatment may be needed to control rodents prior to tree planting. Follow-up with a selective herbicide may be needed for two to three years until trees are well established. Follow locally approved tree planting practices for the establishment of the trees.

Tree Management

Determine the tree management needs.

- **Thinning.** Trees generally have little impact on forage production until shading becomes dense enough to limit sunlight to the understory. Thinning of trees is

scheduled to reduce canopy shade and tree competition for understory forage production. When the trees' combined canopy exceeds 35 to 45 percent, forage production of warm season grasses begins to decline. However, there are differences among the warm season grasses. For instance, Pensacola bahiagrass and Coastal bermudagrass were shown to produce more under tree canopy cover then dallisgrass and carpetgrass. Continuous observation is important in making adjustment in the management strategy. For cool season grasses, shade tolerance of some species may exceed 60 percent and still produce good forage yields. Depending upon the species of grass, tree thinning needs to be conducted to keep canopy cover below the maximum shade tolerance level. With proper establishment densities the first thinning should be planned around 10 to 15 years of age for pulp or small round wood. Successive thinnings can be scheduled about every five years until final harvest at approximately 30 to 45 years. This schedule will vary some depending upon the productivity of the site, the species of trees, and the targeted, final wood products.

- **Pruning.** Widely spaced trees delay tree canopy closure benefiting forage crops but the "open grown" trees may develop large branches that can reduce wood quality if trees are not pruned. The object of pruning is to confine the knots created by these branches to a small diameter (four inches) of core wood thereby producing high quality, knot free wood on the outer diameter of the tree stem.
  - Pruning should be initiated when the crop trees reach 15 to 20 feet and/or the stump diameter reaches five inches at a height six inches above the ground.
  - Pruning should strive to remove all of the branches where the trunk diameter is greater than four inches. But, never remove more than 50 percent of the live canopy.
  - Pruning operations should be scheduled periodically until the tree bole is pruned up to 18 feet. Each successive pruning operation proceeds up the main tree stem to a four-inch diameter core but removes no more than 1/3 to 1/2 of the total crown while maintaining a live crown equal to 1/3 of the tree height.
  - Pruning operations continue until a 18-foot knot-free log is developed. (see figure 2) Follow local guidelines from the state forestry agency, NRCS or extension service for proper pruning techniques.
- **Grazing Management.** Very young trees are subject to browsing or trampling by

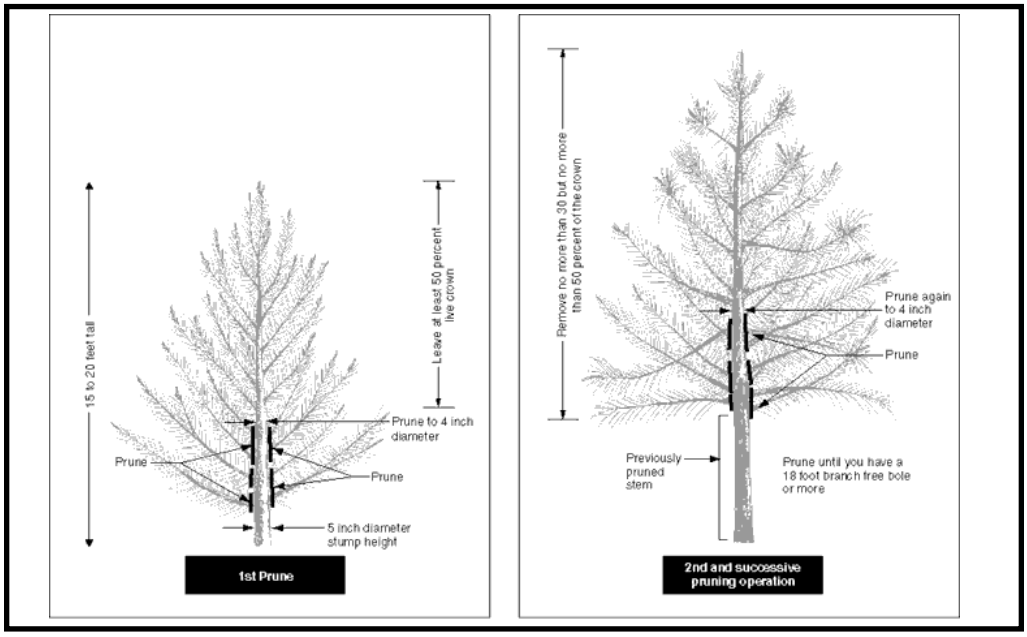

Figure 2: Pruning to create a four inch core.

livestock. It is recommended that grazing be restricted or excluded during the first two to three years after establishment or until the terminal bud of the trees is above the reach of livestock. Forage produced during these years can still be mechanically harvested and utilized for hay. Once the terminal bud of the trees is above the grazing height of livestock (six to eight feet), grazing can proceed without damage to the trees. If heavy browsing is observed there may be a deficiency in the livestock diet. Southern pine are not typically browsed by livestock when adequate quality forage is available.

As with any managed grazing system, soil amendments should be applied as needed to maintain desired forage production levels. An added benefit is that stem production of wood has been shown to increase by 20 to 30 percent in response to fertilizer management for forage production.

Continuous grazing is not recommended for silvopasture systems. A planned grazing system in which multi-grazing units are rested and grazed in a planned sequence should be developed. The grazing management plan should maintain an adequate balance between livestock numbers and forage production.

Close monitoring of forage, livestock and timber performance will provide economic and environmental benefits attainable through silvopasture systems.

Additional Information

"An Ongoing Study to Understand Tree, Forage, and Livestock Systems." Clason, T. R. 1998. *Inside Agroforestry* 12(2):1, 5.

"Agroforestry, Proceedings Southeastern Regional Conference Grazing Lands and People"; Pearson, Henry A. 1984. Editors Merkle, Dan; Carter, Roy; Artz, John L.; December 10-12; Atlanta, GA. 72-79.

"Development of Silvopastoral Systems in the Northern Temperate Zone." Clason, T. R. 1996. *Inside Agroforestry* 10(2): 3-7.

"Double vs. Single-Row Pine Plantations for Wood and Forage Production." Lewis, Clifford E., Etal. 1985. *Southern Journal of Applied Forestry,* Vol 9, No.1. 55-60.

"Economic Implications of Silvipastures on Southern Pine Plantations." Clason, T.R. 1995. Louisiana Agricultural Experiment Station, in *Agroforestry Systems* 29:227-238.

"From a Pine Forest to a Silvopasture System." Clason, T.R. and J.L. Robinson. 2000. USDA NAC *Agroforestry Note* 18. Pp. 1-4.

"Integration of Pines, Pastures, and Cattle in South Georgia, USA"; Lewis, Clifford E.; etal. 1983. *Agroforestry Systems.* 1 : 277-297.

"Managing Pine Trees and Bahiagrass for Timber and Cattle Production" Byrd, Nathan A., Lewis, Clifford E. 1983. USDA Forest Service, General Report R8-GR 2. Pp. 1-9.

"Silvopastoral Practices Sustain Timber and Forage Production in Commercial Loblolly Pine Plantations of Northwest Louisiana USA." Clason, T.R. 1999. *Agroforestry Systems* 44: 293-303.

"Timber-Pasture Management Enhances Productivity of Loblolly Pine Plantations." Clason, T. R. 1996. *Louisiana Agriculture* 39(2): 14-16.

Authors

James L. Robinson, NRCS Agroforester, USDA National Agroforestry Center, USDA NRCS, GLTI, Box 6567, Fort Worth, Texas. Phone: 817-509-3215. E-mail: *jim_robinson@ftw.nrcs.usda.gov*

Dr. Terry Clason, Forestry Research Project Leader, Louisiana State University Agricultural Center, Louisiana Agriculture Experiment Station, Hill Farm Research Station, Route 1, Box 10 Homer, Louisiana. Phone: 318-927-2578. E-mail: *tclason@agctr.lsu.edu*

Contact the USDA National Agroforestry Center (NAC), East Campus-UNL, Lincoln, Nebraska 68583-0822. Phone: 402-437-5178; fax: 402-437-5712; web site: *www.unl.edu/nac.*

NAC is a partnership of the USDA Forest Service, Research & Development (R&D) (Rocky Mountain Research Station) and State & Private Forestry (S&PF) and the USDA Natural Resources Conservation Service. The Center's purpose is to accelerate the development and application of agroforestry technologies to attain more economically, environmentally, and socially sustainable land-use systems. To accomplish its mission, the Center interacts with a national network of cooperators to conduct research, develop technologies and tools, establish demonstrations, and provide useful information to natural resource professionals.
