

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE SPECIFICATION GUIDE**

SILVOPASTURE

(Ac.)

CODE 381

GENERAL SPECIFICATIONS

Procedures, technical details and other information provided in this specification will be used as a guide to carry out a proper design, establishment and management of silvopasture.

INTENDED APPLICATION

Silvopasture is an agroforestry system that intentionally integrates trees, forage grasses/legumes and livestock on an environmentally sustainable basis. Trees in pasture provide shelter for livestock during periods of inclement weather. This can significantly improve animal performance during particularly hot times of the year. Trees 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.



Trees may provide other benefits such as carbon sequestration, and nitrogen fixation. Incorporating trees in pastures add structural diversity and resources that enhance the biodiversity and scenic characteristics of pastureland. The forage and the tree component may be either native or introduced.

PLANTS

Species selection for trees

When making tree and forage crop selections, consider potential markets, soil types, climatic conditions, equipment needs, and species compatibility. Select and use trees and planting/harvesting patterns that are suitable for the site, compatible with planned practices and provide desired economic and environmental returns

Tree species should be used from an approved list for silvopasture species. Native trees should be favored where ever possible. See Table 1 for a list of suitable tree species.

Hardwoods and tree species with high nitrogen fixation potential such as legumes are encouraged. Some trees such as the Puerto Rican royal palm (*Roystonea borinquena*), and Capá blanco (*Petitia dominguensis*), provide fodder and shelter for certain birds.

Table 1. Suitable trees for Silvopasture. (not exclusive)

English Common Name	Spanish Common Name	Scientific name
Bastard stopper	Capa blanco	<i>Petitia dominguensis</i>
Black olive	Úcar	<i>Bucida buceras*</i>
Cabbage angelin, cabbagebark	Moca	<i>Andira inermis*</i>
Dominican mahogany	Caoba dominicana	<i>Swietenia mahagony*</i>
Earpod tree	Guanascaste	<i>Enterolobium cyclocarpum</i>
Honduras mahogany	Caoba hondureña	<i>Swietenia macrophylla</i>
India padauk	Pterocarpus	<i>Pterocarpus indicus</i>
Puerto Rico royal palm	Palma real	<i>Roystoneaborinquena*</i>
Raintree	Saman	<i>Pithcellobium saman</i>
Quik stik	Madre de cacao, mata raton	<i>Gliricidia sepium*</i>
Teak	Teca	<i>Tectona grandis</i>
Turpentine	Almácigo	<i>Bursera simaruba*</i>

*Specie with wildlife value (pollinator, food/shade)

Protein banks consist of pasture paddocks managed mostly to provide high quality protein to livestock. Usually tree species used as protein banks are pruned to a size where livestock can graze the forage directly (usually 3 to 4 feet height).

Grazing/browsing protein banks require a prescribed grazing schedule in order to maintain high yields and forage quality. Legume species recommended for protein bank include Mother of cocoa (*Gliricidia sepium*) and improved varieties of Zarcilla (*Leucaena leucocephala*).

The use of vegetative material (as living stakes), as part of the fence, is a common practice in the Caribbean Area.

Living stakes must be 7 to 8 feet long and have a diameter between 2.5 to 3 inches or more. These can be planted every 8 to 40 feet or more depending on user objectives and on the tree species. Planting depth must be 15 to 20 inches. Plant

trees at random, considering topography and user objectives. The following table is an abbreviated list suitable for living stakes.

Table 2. Trees suitable for living stakes. (not exclusive)

English Common Name	Spanish Common Name	Technical Name	Minimum Spacing in Line (ft.)	Habitat lowland and upland	
				Semiarid	Humid
Turpentine	Almácigo	<i>Bursera simaruba</i> *	8	X	X
Mountain immortale	Bucaré, Bucayo gigante	<i>Erythrina poeppigiana</i>	16		X
Prickly ash	Espino rubial	<i>Zanthophyllum martinicense</i> *	8	X	
	Guaba	<i>Inga vera</i> *	16		X
Mother of cacao	Mata ratón, San José	<i>Gliricidia sepium</i>	8	X	X
Cabbage bark	Moca	<i>Andira inermis</i>	16		X
Old woman,s bitter	Péndula, Bálsamo	<i>Citharexylum fruticosum</i> *	8	X	X
White oak	Roble blanco	<i>Tabebuia heterophylla</i> *	8	X	X
Pink trumpet-tree	Roble venezolano	<i>Tabebuia rosea</i>	16		X
Fustic	Tachuelo	<i>Pictetia aculeata</i>	8	X	
Black olive	Úcar	<i>Bucida buceras</i> *	16	X	X

Tree planting stock

Tree planting stock should be at least 1-2 feet tall with at least a ½ 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. Soil should be firmly packed around seedling roots. Newly planted seedlings should be protected until their height growth is above the browse reach of livestock.

Tree establishment

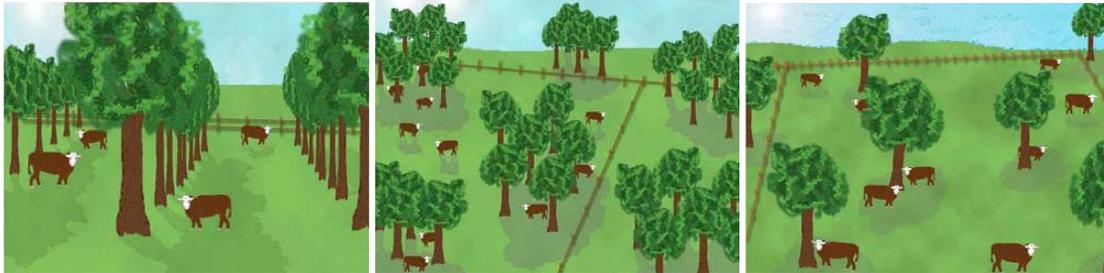
Tree establishment in existing grass fields can be difficult. Items to consider for tree establishment include:

- 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 minimum, vegetation should be controlled in a three-foot diameter around each tree or row for 2 to 3 years.
- Number of trees –
 - Timber: 100 to 200 trees per acre;
 - Shade: 10 trees acres;
 - Living fences: depending on user objectives and on the tree species;
 - Protein banks: depending on species but generally 5 X 7 feet in rows.

Tree layout

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 width needs.

Plant trees in single, double or triple row sets. Cluster plantings may also be used. When multiple row woody planting sets are used, stagger within row plantings (See diagrams below).



Trees in rows

Trees in clumps

Single trees

Source: IS-MO381

For existing forest plantations/stands, reduce stocking levels to at least a 50% 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.

Planting dates

Plant trees at the beginning or during the rainy season. Planting will be done at time and manner to insure survival and growth of selected species. For planting dates see, NRCS Conservation Practice Tree Shrub Establishment Specification Guides Code 612.

Species selection for grass/legumes

Forage species should be used from an approved list for silvopasture species. 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 the Table 3.

TABLE 3. EXAMPLES OF GRASSES AND LEGUMES SUITABLE FOR USE IN SILVOPASTURE. (this list is not exclusive)

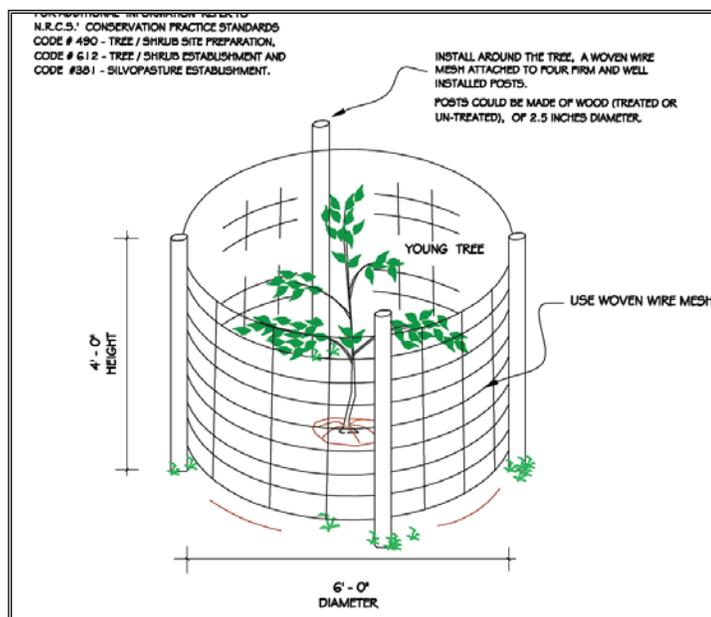
Type	English Common Name	Spanish Common Name	Scientific name
Grasses	Angleton /Kleberg	Pajón mejorado	<i>Dichanthium annulatum</i>
	Buffel grass	Bofel	<i>Pennisetum ciliare</i>
	Carib Grass	Malojilla	<i>Eriochloa polystachya</i>
	Guinea grass	Guinea	<i>Megathyrsus maximus</i>
	Napier grass	Elefante	<i>Pennisetum purpureum</i>
	Pangola grass	Pangola	<i>Digitaria eriantha</i>
	Pará grass	Malojillo	<i>Urochloa mutica</i>
	Signal grass	Signal	<i>Urochloa brizantha</i>
Star grass	Estrella	<i>Cynodon nlemfuensis</i> var. <i>nlemfuensis</i>	
Legumes	Tan tan, wild tamarind	Zarcilla	<i>Leucaena leucocephala</i> (Improved varieties)
	Purple bushbean	Sirato	<i>Macroptilium atropurpureum</i>
	Ticktrefoil	Pega pega	<i>Desmodium spp</i>
	Wild bushbean	Habichuela para	<i>Macroptilium lathyroides</i>
	Willd. wild tantan	Desmanto	<i>Desmanthus virgatus</i> (L)

Protection

Protect the trees from grazing during establishment utilizing protective measures such a cage made out of woven wire or by utilizing the field for hay until the trees are tall enough and strong enough to withstand grazing pressure.

This measure will provide protection to the tree from browsing while livestock graze the rest of the pasture. Enclosure consists of a cage made out of woven wire. For the woven wire description, see Access Control Code 472.

The enclosure dimension is 6 feet diameter by 4 feet height.



Invasive species

Some trees may become invasive depending on management and climate conditions. These could include introduced species such as *Albizia procera*, *A.lebbek*, and *Spathodea campanulata* among others.

Utilities

Do not plant trees close, over or under structures, electric lines, underground pipes, sewage systems, and watering facilities such as concrete water troughs or tanks.

Livestock

Potential livestock choices include cattle, sheep, goats or horses. The selected livestock system must be compatible with tree, forage, and environmental requirements. In general, browsing animals such as sheep or goats are more likely to eat trees; whereas, large grazing animals such as cattle are more likely to physically break young trees. Younger livestock are more prone to damage trees than older, more experienced animals. Livestock like 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 silvopasture for prolonged periods. Browsing damage can sometimes be eliminated by removing a few problem animals. Trampling of very young 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, protected from 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 management similar to pastures.

Management

At a minimum, vegetation should be controlled in a three-foot wide band around each tree for two to three years. 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 four to six foot diameter competition-free zone around each tree.

Livestock grazing should be intensively managed. A successful silvopasture requires understanding forage growth characteristics and managing the timing and duration of grazing to avoid 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 100 feet of water
- Make paddocks as near to square as possible
- Follow landscape lines for paddock boundaries
- Make paddocks of similar grazing capacity according to yields
- Plan lanes for livestock movement

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 in a silvopasture system.

Available management tools include:

- tree harvesting, thinning or pruning
- fertilization to improve both forage and tree production
- planting legumes for nitrogen fixation and forage production
- multi-pasture, rotational grazing
- supplemental feeding
- water source development (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

References

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