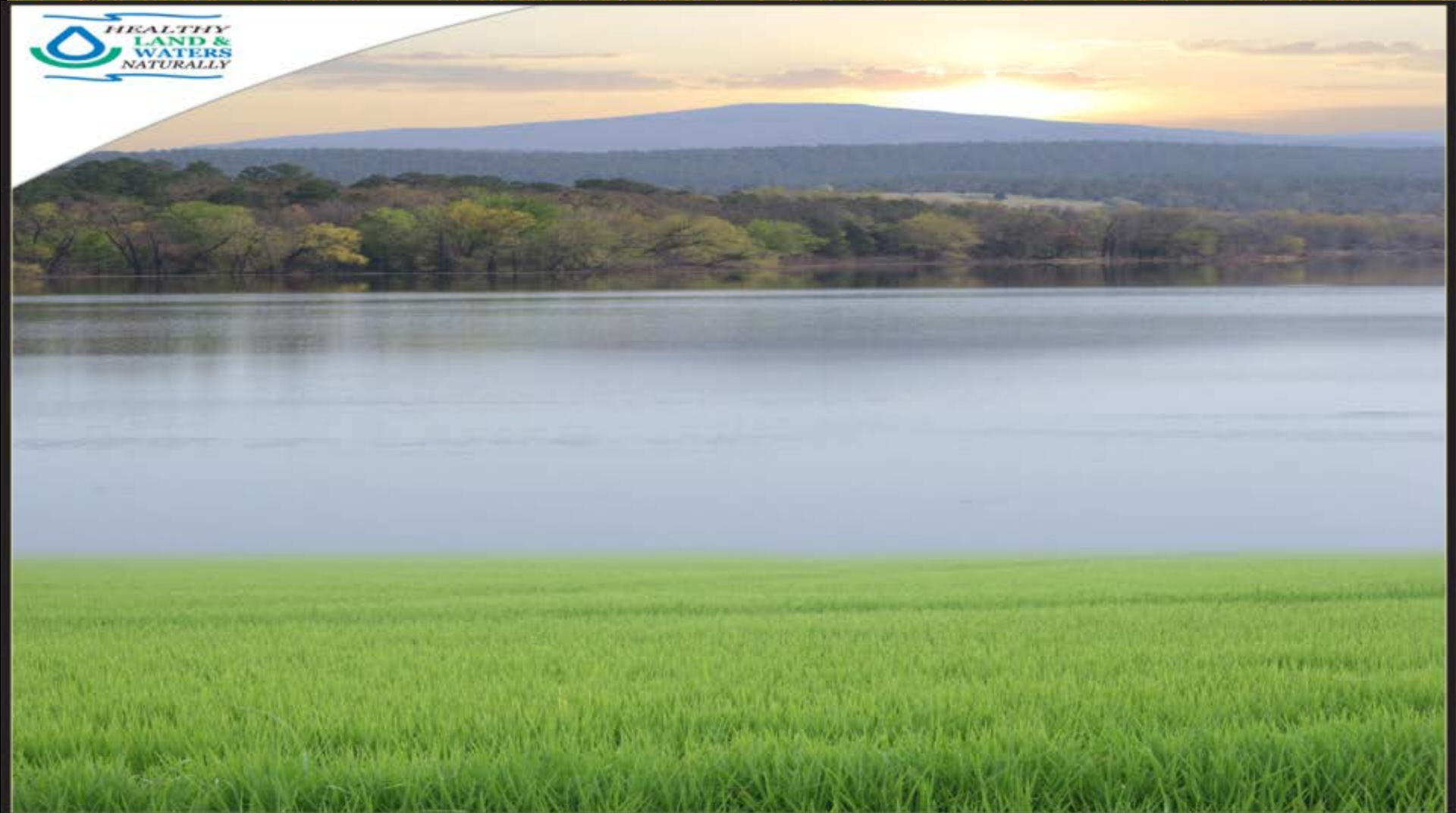


Arkansas Grazing Lands Conference

**George Rheinhardt, Forester
USDA Natural Resources Conservation Service**

March 13, 2013



Healthy Land and Waters ... Naturally

www.ar.nrcs.usda.gov



United States Department of Agriculture
Natural Resources Conservation Service

NRCS is an Equal Opportunity Provider and Employer



What is Agroforestry?



+





Agroforestry is...

The **intentional** mixing of trees and/or shrubs into crop/animal production systems to create environmental, economic and social benefits.



Why are these trees pruned?



Why Agroforestry?

Good Cent\$

- Produces salable products
- Provides value-added opportunities
- **Diversifies risk**
- Increases property values
- **Increases crop yields & livestock production**
- Eligible for cost-share & land rental payments





**CONSERVATION WITHOUT
COMPENSATION
IS JUST
CONVERSATION**

**Conservation practices have to make
economic sense!**



Agroforestry Practices



Alley Cropping



Silvopasture



Forest Farming



Riparian Forest Buffers



Windbreaks

***Putting the right plant,
in the right location,
for the right reason.***



Silvopasture

Combines timber and forage production. Trees provide **longer-term returns**, while livestock generate an **annual income**.





Is this Silvopasture??

A photograph of a rural landscape. In the foreground, a wire fence with wooden posts runs across the frame. Beyond the fence is a large, open grassy field. On the left side, a dense row of tall, mature pine trees extends into the distance. Several cows are scattered throughout the field, some near the trees and others further away. In the background, there are rolling hills, more trees, and a few buildings under a cloudy sky.

Is this Silvopasture?



Silvopasture

- Forest management, while generating forage production in the understory
 - **NOT Shade trees on pasture**
 - **Must have a crop of GOOD trees!**
- Many cool and warm season grasses and legumes yield high levels of quality forage when grown under as much as **50 percent shade**
- **Improves** Cool Season Grass & Legume production
- **Allows** Warm Season Grass production with tree canopy management



Silvopasture

CAN HAVE TREES AND GRASS TOO!



Silvopasture

- Design integrated timber/grazing systems in planted **conifer stands**, especially in the South and Southeast
- Work well in southern pines
- Not normally used for planted hardwood species
 - Can if managed right
 - Can start with trees and add grass
 - Hard to have grass and add trees



Silvopasture

- **High value sawlogs** can be grown as a long-term product while on the same acre an annual income can be generated from **grazing livestock**.



Silvopasture

- Takes advantage of the inherent differences in trees and grasses
- Trees and grasses capture light and exploit soil resources differently
 - **Room to grow for grass** if let light through the canopy
- Trees are **planted less densely** than they would under a typical forest management
- Allow **sunlight to reach the understory** forage crop.





Silvopasture

- Silvopasture systems can be initiated by planting trees into an **existing pasture**
- **Existing forests** can be **thinned** and pruned to allow the light to reach the understory
 - **Hardwood or pine**

▶ Getting Started

Trees in a are planted at **lower densities** than traditional forestry plantations.

A healthy planting range for silvopasture establishment is typically between **200-400 trees per acre.**



▶ Lower Density Effect on Forage and Cattle

Lower density stands permit enough sunlight to penetrate to the forest floor to **stimulate forage growth**.

Shade allows cattle to graze throughout the day with **reduced sun stress**.



▶ Alley Widths



Consider the width of the equipment that will be used

**Alley Width is Most Important planning decision!!
(20' is not enough)**



Site conditions and **producer objectives** should ultimately dictate the desired planting arrangement.



► Canopy Dynamics

As trees mature, the canopy closes between rows.



► An Integrated System

Once established, both forages and trees co-exist and can contribute to a highly productive silvopasture system.





Silvopasture

- Arrangement & Design
- Single Row
- Double Row
- Triple and Quadruple
- Texas allows 5 rows
 - If 10' rows and 40' alley – plant ½ of ground
 - Take outside rows at first thinning
 - **No pruning**
 - Leaves 3 rows to be thinned
- Block Planting
 - Trees evenly spaced at wide spacing
- **Can plant any configuration**
 - **Must be more than 200 tpa and less than 400 tpa**
 - For PLANTING and not thinning existing stands

5 row set with 40' Alley 2010



5 row set with 40' Alley / 2010



5 row set with 40' Alley Now




5 row set with 40' Alley Now



5 row set with 40' alleys in Searcy County After 2 growing seasons (2013)





Silvopasture – Starting with Pasture

**MOST IMPORTANT DECISION IS
HOW WIDE TO MAKE THE ALLEY**

- Technote published by the National Agroforestry Center “**Pasture to Silvopasture**”
- Rows will be laid out with wide alley
- Typical tree planting density is from **200 to 400** trees per acre.
- Strip tillage or herbicide or both is used where the rows will be established.
- Often the row will be sub soiled or ripped to improve moisture penetration and root development.





Silvopasture – Starting with Pasture

- Safest if the first 2 to 4 years the forage is used for hay.
 - Depends on how much tree damage **owner** can tolerate
 - Stock pile the grass the first year and pasture it in fall (Flash graze)
 - Do not pasture it the **first spring!**
 - **MOST** susceptible the second year
- Important that the row spacing is planned to fit the haying equipment!



Tree!





Silvopasture – Starting with Pasture

- **Herbicide may be needed until trees are released from the grass competition.**

Herbicide





Silvopasture – Starting with Pasture

- Unlimited rotational Grazing according to plan can begin when:
 - Tip of tree is above the reach of the cow
 - **Trees big enough to tolerate rubbing**
 - Could be after 2 years or 3 years depending on site

- Grazing is limited before this
 - **Do ONLY as much as the trees can tolerate!**
 - **As much as owner can tolerate!**
 - Depend on quality of the site
 - Or as much as the landowner can stand
 - There will be breakage if cows are around trees

- Grazing must be done under a grazing management plan
 - minimize impacts to trees.

Can the cow reach the top of these trees?



Cows will rub on trees





Some rub more than others



There will be breakage!





Silvopasture – Starting with Trees

- Technote titled “**From Plantation to Silvopasture**”.
- Stand is thinned to reduce stand density and open the canopy
 - **Hardwood have denser shade than pine**
- Depending upon the species of grass.
 - **Cool season grasses can tolerate greater canopy (more shade) than warm season grasses.**

Alleys created in older plantation

Picture taken 2010

Had continuous grazing since planted



Alleys created in older plantation Now







Prescribed burn is conducted to clean up the trash and debris - CAREFULLY!!





- Grass is established using standard establishment techniques
- Tillage options should take care not to damage roots or trees.



Sprig or seed the desired grass species





Fertilize for desired production





Established Agroforestry system know as Silvopasture





Silvopasture – Must Prune Trees!

(wider spaced plantings not older stands thinned)

- **Planted trees next to alleys or wide rows keep branches**
 - Trees in older stands are naturally pruned
 - Branches do not grow back when thinned
- **Trees are growing in open condition retain branches**
- **Pruning is a **must to grow quality trees.****
- **Prune no more than two thirds of height!**



Silvopasture – Must Prune Trees!

- **Can use herbicide to prune pine**

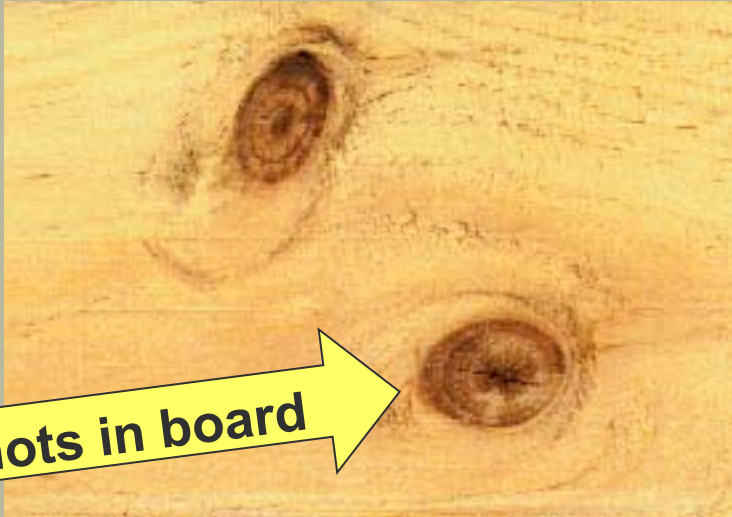


Open Grown Trees will be LIMBY!!

▶ Pruning a Pine Plantation?

Trees grown in lower density silvopasture produce more branches

- Branches affects eventual lumber quality by producing knots



Knots in board



Open grown loblolly pine

▶ When to Prune

The first pruning should be initiated in the late winter or early spring when the trees have reached 15 to 20 feet tall.



► Other Benefits of Pruning

- Pruning allows more sunlight to hit the ground stimulating forage growth and creating an open, aesthetic environment



► Frequency and Expense

- Create 16' clear log
 - (17' to 18' height)
 - Better if done in more than one step
- EQIP pays
 - \$0.78 lower 8 ft
 - \$1.93 upper 8 ft
 - \$2.30 in one step









Prune only the final crop trees

At least 100 trees per acre



► Canopy density

A 25% to 60% canopy is needed to sustain warm to cool season

- As the trees planted in a silvopasture system begin to grow, their canopies produce more shade
- While **pruning** trees helps to open up the canopy, **thinning** is also necessary to maintain forage production and develop higher-quality timber



▶ When to Thin

Planting arrangement plus tree growth dictates thinning

- **Pines on good sites can be typically be thinned when they reach 12-15 years**



▶ When to Thin

- Depending on density, thinning may be needed every 5-7 years to remove canopy, improve tree quality, and sustain forage production





Rotational grazing is a must!!





As is adequate water





Silvopasture

- **Livestock provide improved cash flow for the timber owner**
- **Gives product stability**

▶ Other silvopasture options

Not Pine Trees and Cows



► Silvopasture with Goats

Goats can be introduced to clean out forests of invasive species and undesirable plants such as brambles and vines.



► Other tree species for silvopasture

Many different tree species have been integrated successfully

Pecan and black walnut are popular choices.





Silvopasture

- **Research from the LSU Hill Farm shows:**
- **No statistical difference in the weaning weight production from silvopasture as compared to open pasture.**



From Technote “From Plantation to Silvopasture

Pasture made slightly more Bermudagrass

Coastal Bermudagrass Under Pasture and Silvopasture

Stand Age (Years)	Pasture (Tons/Acre)		Silvopasture (Tons/Acre)	
	Low Yield*	High Yield**	Low Yield*	High Yield*
21	1	1	0.8	0.8
22 to 35	2	3 to 5	1.5	3 to 4

*Low yield — Below average rainfall, 168-day grazing season.

**High yield — Average rainfall, 168-day grazing season.



From Technote “From Plantation to Silvopasture

More wood from fewer trees!

Approximate Wood Yields of Loblolly Pine Under Silvopasture and Pine Plantation

Stand Age (Years)	Silvopasture		Plantation	
	Cords/Acre	Board Feet Acre*	Cords/Acre	Board Feet Acre*
20	33	0	27	0
25	3	2000	3	1600
30	0	3000	1	2100
35	0	4000	1	3100

*Doyle Scale



Not sure of the source of the data (from James Robinson slide show)

More wood with fewer trees!!!

Timber Production

35 Year wood yields

Total Yield

900 TPA	49 Cords
300 TPA	55 Cords
100 TPA	49 Cords

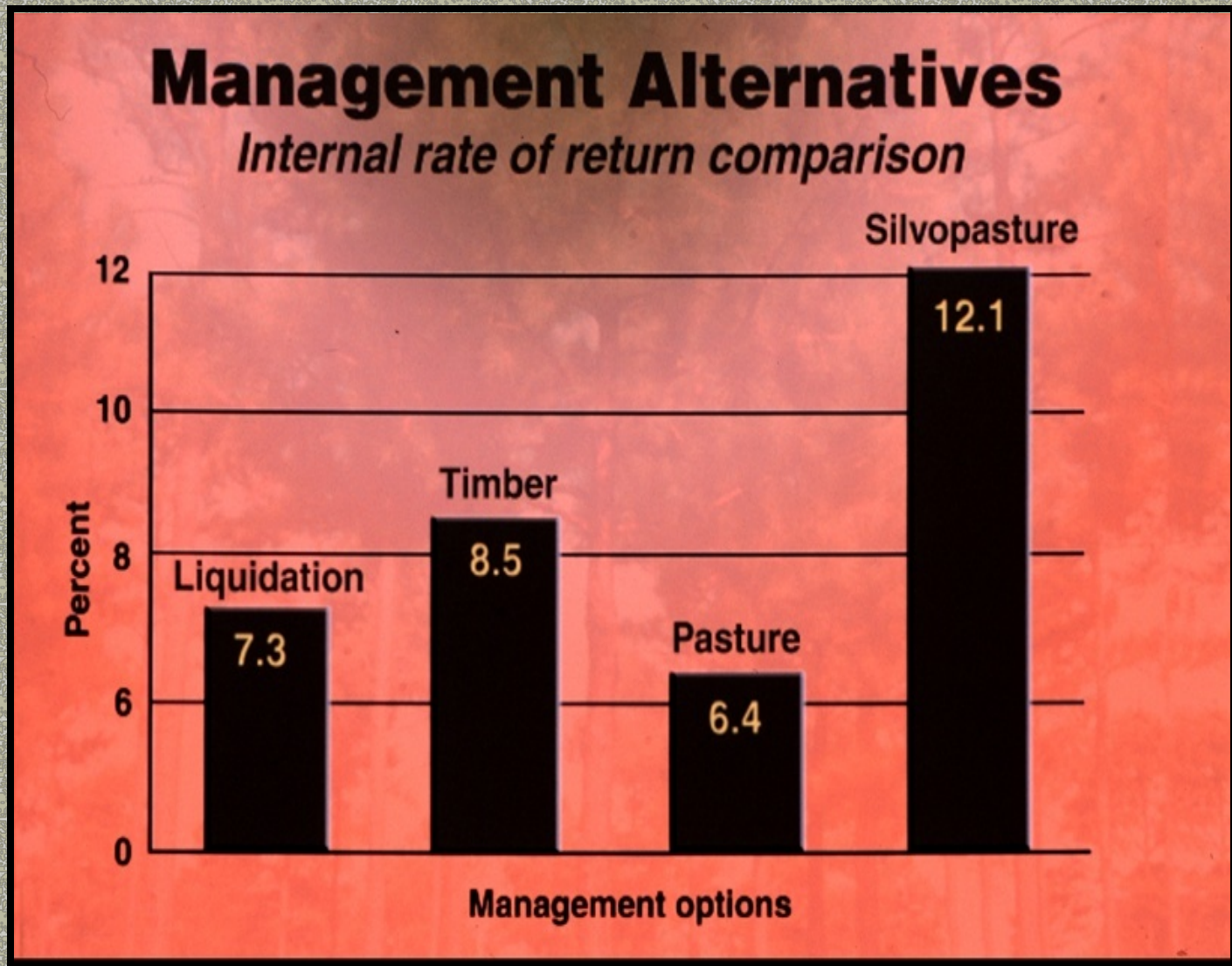
Timber Production

35 Year wood yields

Total Yield

900 TPA	4,900 Bd ft
300 TPA	6,400 Bd ft
100 TPA	12,200 Bd ft

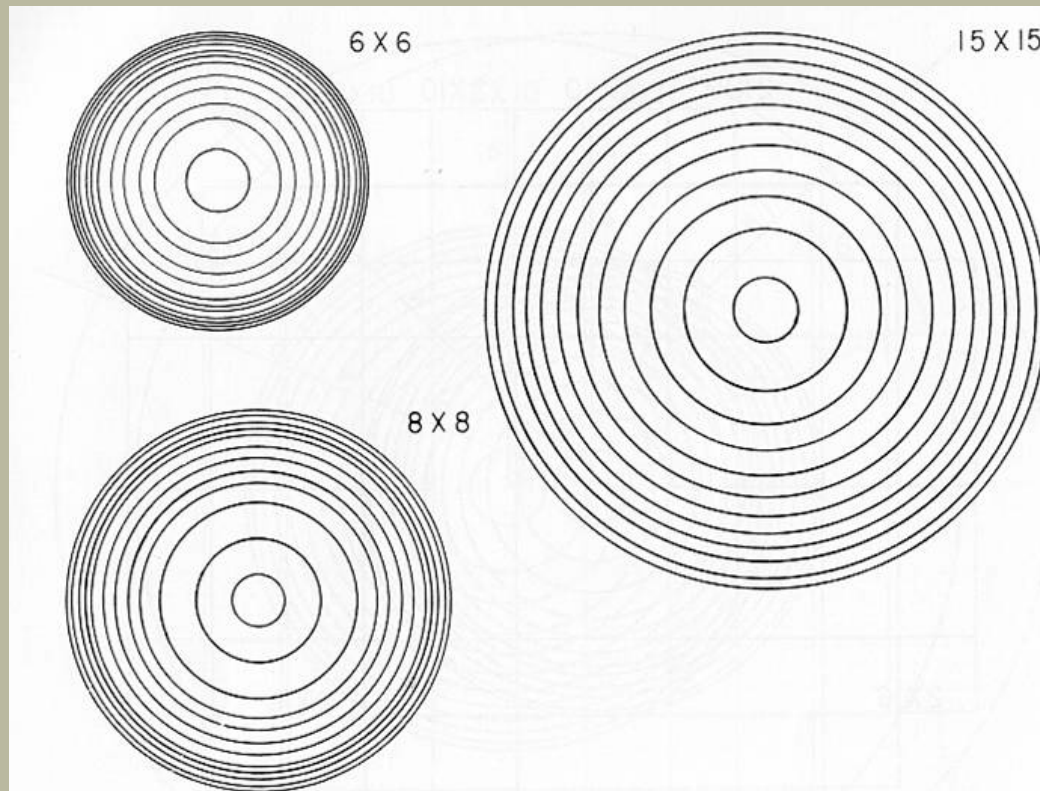
From the publication: Clason T.R., 1995 "Economic implications of silvopasture on southern pine plantations", *Agroforestry Systems* 29:227-238.



▶ Lower Density Effect on Tree Diameter

Tree diameter growth in **lower density** stands is **accelerated** due to reduced competition.

Bigger trees quicker!





Wood Quality

- Tree age, not growth rate, affects specific gravity most
 - .01 SG = 50 lbs dry matter per cord
- Fewer Trees per Acre = Fast Growth
- Fast Growth = Merchantable Trees Quicker
- **Size has higher value than rings per inch**
- Wide spaced trees yield more tons per acre of sawlogs
- Wide spaced trees have equal or higher specific gravity for same age



Trees and forages is an option for the application of animal waste
Easier to apply with wide alley





Good management will assure the desired results





- **Slash pine silvopasture 18 years old**
- **George Owen Farm Chipley, Florida.**
- **Forage is Bahia grass and Crimson clover**
- **What foresters would normally picture**





Same field as previous picture

Showing the double row set of trees

Original spacing was 6 feet in the row and 8 feet between rows with 30 feet between row sets.

382 TPA at planting





**Hardwood Forest Managed with Forest
Stand Improvement**

Removed mid and understory



**Forest Stand Improvement and
Prescribed Burn**

**Removed mid-story and did
prescribed burn**



SAME

- 
- Examples of BAD management (The tree not George)
Continuous grazing when trees are too small





Some More





And More





And More





Still might make a tree



Damage worse around loafing area





Bull was scratching





**Double row with 6' in row 10' between row and 20' alley
(not wide enough alley)**

484 TPA Planted in 2002 (picture taken in 2005)

Too many trees (forester trying to ease out of cows)

East – West Row in summer – note the shade





Same picture one year later in March 2006
Note the shade





**Same area picture taken in March 2013 (11 years old)
Trees have been pruned to about 12 ft**





Same area picture taken in March 2013 (11 years old)
Trees have been pruned to about 12 ft



Green in alley →

→ Not Green in row



Same area

Will thin trees in two years and light will get better





Picture taken in March 2013

Next to previous picture in area with no alley

Trees not pruned

Note lack of light on ground

Skips and pruning let in light (not here)





Picture taken in March 2013


Trees Planted in 2003

Next to previous picture in area with no alley but pruned

Note light on ground

Pruning lets in light





**Loses are within acceptable limits for my objectives
Have plenty of trees (too many) more like operational plantation
Need to thin to get good grass**





Silvopasture

CAN HAVE TREES AND GRASS TOO!

- **Better for pine**
- **Can be hardwood**
- **Can use Forest Stand Improvement to open up the forest**
 - **Can NOT use Forest Stand Improvement to convert to non-forest**
- **Must have a merchantable timber crop!**
- **Crop trees must be the best trees!**

For More Information Contact:

USDA National Agroforestry Center

Lincoln, NE 68583-0822

ph: 402-437-5178

www.unl.edu/nac





Agroforestry Notes

USDA Forest Service, Rocky Mountain Research Station • USDA Natural Resources Conservation Service

November, 1997

Silvopasture: An Agroforestry Practice

Definition

Although some form of silvopasture management has been practiced for centuries, silvopasture as an agroforestry practice is specifically designed and managed for the production of trees, tree products, forage, and livestock. Silvopasture results when forage

AF Note — 9



Agroforestry Notes

USDA Forest Service, Rocky Mountain Research Station • USDA Natural Resources Conservation Service

November, 1997

The Biology of Silvopastoralism

Introduction

Forestry and livestock grazing are common competing uses for non-irrigated lands around the world. Forest grazing is a traditional practice in most of North America. Approximately 25 percent of all US forest land is grazed by livestock. Young forests



Agroforestry Notes

USDA Forest Service • USDA Natural Resources Conservation Service

AF Note — 18

April, 2000

From Pine Forest to A Silvopasture System

Introduction

Agroforestry systems hold the potential for land users to realize diverse income-generating possibilities from the same acreage, as well as meet environmental goals. Silvopasture systems are agroforestry systems that incorporate the production of forage and/or livestock with the growing of trees for a



USDA National Agroforestry Center

AF Note — 22

AGROFORESTRY NOTES

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 main-

Silvopasture — 5

USDA National Agroforestry Center

AF Note — 26

AGROFORESTRY NOTES

September 2003

Converting A Pasture to A Silvopasture in the Pacific Northwest

Silvopasture — 6

USDA National Agroforestry Center

AF Note — 28

AGROFORESTRY NOTES

February 2005

Silvopasture and Eastern Wild Turkey

Introduction

Trees and livestock account for much of the income production on lands throughout the southern United States. Today many landowners are combining these two operations into one system called silvopasture, where both timber and livestock are produced on the same field.

While economic gain is most often the primary goal of a silvopasture system, wildlife habitat enhancement is commonly seen as an added benefit. This *Agroforestry Note* discusses the habitat requirements of Eastern wild turkey with respect to management considerations for the production of timber and livestock forage within silvopasture systems.



Silvopasture Water and Fencing Systems for Cattle

Introduction

Silvopasture is an agroforestry system that combines grazing livestock with growing trees for a timber product. Creating small, fenced paddocks and rotating cattle builds in "recovery periods" for the forage and protects the soil and trees. In a silvopastoral system, grazing recovery periods can only be achieved when well-designed livestock water supplies and cross fences are used.

Fortunately, technological advances in livestock water system design and fence materials have helped to create a feasible working environment where rotating livestock from one silvopasture paddock to another can be both convenient and affordable. However, some special considerations must be given to water and fencing in a silvopasture system.



High tensile wire fence and portable water tanks are economical tools for improving silvopasture utilization.

Water

Animals acquire water through drinking and from the moisture in the forage they eat. As air temperature increases water requirements also increase. This becomes especially critical as air temperatures exceed 77° F. The need for available drinking water is compounded because forages become drier at higher temperatures. At 90° F, a 600 pound growing steer needs about 13 gallons of water per day. At 60° F, that need falls to eight gallons per day. One distinct advantage of a silvopasture system is that shade is distributed throughout the pasture and greatly reduces high temperature stress on livestock.

Water Requirements

Water requirements vary for the kind, size, age, and breed of livestock. For example, Bos taurus breeds of cattle (European types) generally consume more water than Bos indicus breeds (such as Brahman-influenced breeds). Dairy breeds need significantly more water than beef breeds. The rule-of-thumb used by some livestock managers is one gallon of water per day per 100 pounds of body weight per animal. Table 1 further illustrates the wide range of water intake needed by different types of livestock. Water use also varies considerably depending upon the animal's health, air temperature, water temperature, stage of lactation, and other environmental factors.

Table 1
Water Intake

	Daily needs in gallons per head	
	50° F	90° F
Beef animals		
400 lb. calf	4	10
800 lb. feeder	7	15
1000 lb. feeder	8	17
Cows and bulls	8	20
Dairy animals		
Cows	15	30
Calves	2	12
Replacement heifers	6	15
Bulls	8	20
Horses and mules	8	12
Sheep or goats	1.5	3.5

Source: D.M. Bell, C.S. Howland, and G.D. Lacefield, 2000. Southern Forages and the Foundation for Agroforestry Research, Narrows, Georgia.

Silvopasture Tree Pruning

Introduction

Silvopasture systems integrate forage production and tree production onto the same acres. The trees are planted and maintained significantly further apart than in conventional pine plantations to allow enough light to reach the ground to support economical forage production. Widely spaced trees develop differently than a typical closed-canopy configuration. In a silvopasture, the producer's primary concern with open-grown trees is the management of large diameter branches that can reduce wood quality.

This *Agroforestry Note* discusses the proper timing and techniques for pruning trees in a silvopasture system that will yield trees of higher quality and value.

When to Prune

Four factors determine when silvopasture trees should be pruned: trunk diameter, branch diameter, tree height, and season of the year.

Trunk Diameter

The object of pruning is to confine the knots created by the pruned branches to a small diameter (four inches) of core wood thereby producing high quality, knot-free wood on the outer portion of the tree trunk.

Consequently, prune trees periodically, never more than once per year, before a portion of the tree trunk grows larger than four inches in diameter.

Branch Diameter

Try to remove branches before they exceed two inches in diameter. Pruning wounds larger than this often take longer than one growing season to close. This results in increased consumption of the tree's energy to close the wound, a longer exposure time for pests to invade the wound, and greater potential to reduce wood quality in subsequent wood growth.

Tree Height

The relative portion of the tree height with branches, or live crown, affects the decision to prune in two ways. The first relates to the health and vigor of the tree and the second relates to the structural integrity of the tree and quality of its wood. Branches support the largest proportion of the energy-producing part of the tree, the needles or leaves. Removing too many branches removes leaves, weakening the tree, reducing growth, and making it more susceptible to insect and disease attack. During a single pruning operation, remove no more than one-third to one-half of the total crown. Branches on a tree trunk influence the form and development of the trunk. Trees with less than one-third live crown have poorer wood quality and develop weaker stems. Therefore, maintain a live crown of no less than one-third of the tree height.



Young trees in this silvopasture have been pruned to improve future wood quality and to allow sun light to reach the ground for adequate forage production. Photo courtesy Terry Glason.

Working Trees for Livestock

Working Trees protect livestock from the stressful effects of winter and offer relief in the summer. They can also create diversified income opportunities.



Conventional wisdom in the past has been that livestock and trees can't co-exist. Yet modern agricultural practice is showing that livestock and trees not only can co-exist, but, if properly managed, can provide additional income from land formerly used for a single crop.

Trees can provide livestock with protection from cold wind and blowing snow in winter, as well as from the hot sun and drying winds of summer. And, if commercially desirable timber or nut trees are planted, landowners can enjoy significant additional

Working Trees

NEW - 2008

Silvopasture

An agroforestry practice

Combining *Working Trees* with forage and livestock produces marketable products and maintains long-term productivity.



“We chose a silvopasture system so we could maximize our return from the land—from the cattle as well as the timber—over the next 20 to 25 years.”
—George Owens, Chipley, FL

Silvopasture integrates trees, livestock, and forage into a single system on one site.

These components diversify income sources. Annual income from grazing and long-term profits from trees respond to different market pressures and reduce risk when combined in the same operation.

Shade from the trees lengthens the forage growing season and improves forage quality. It also

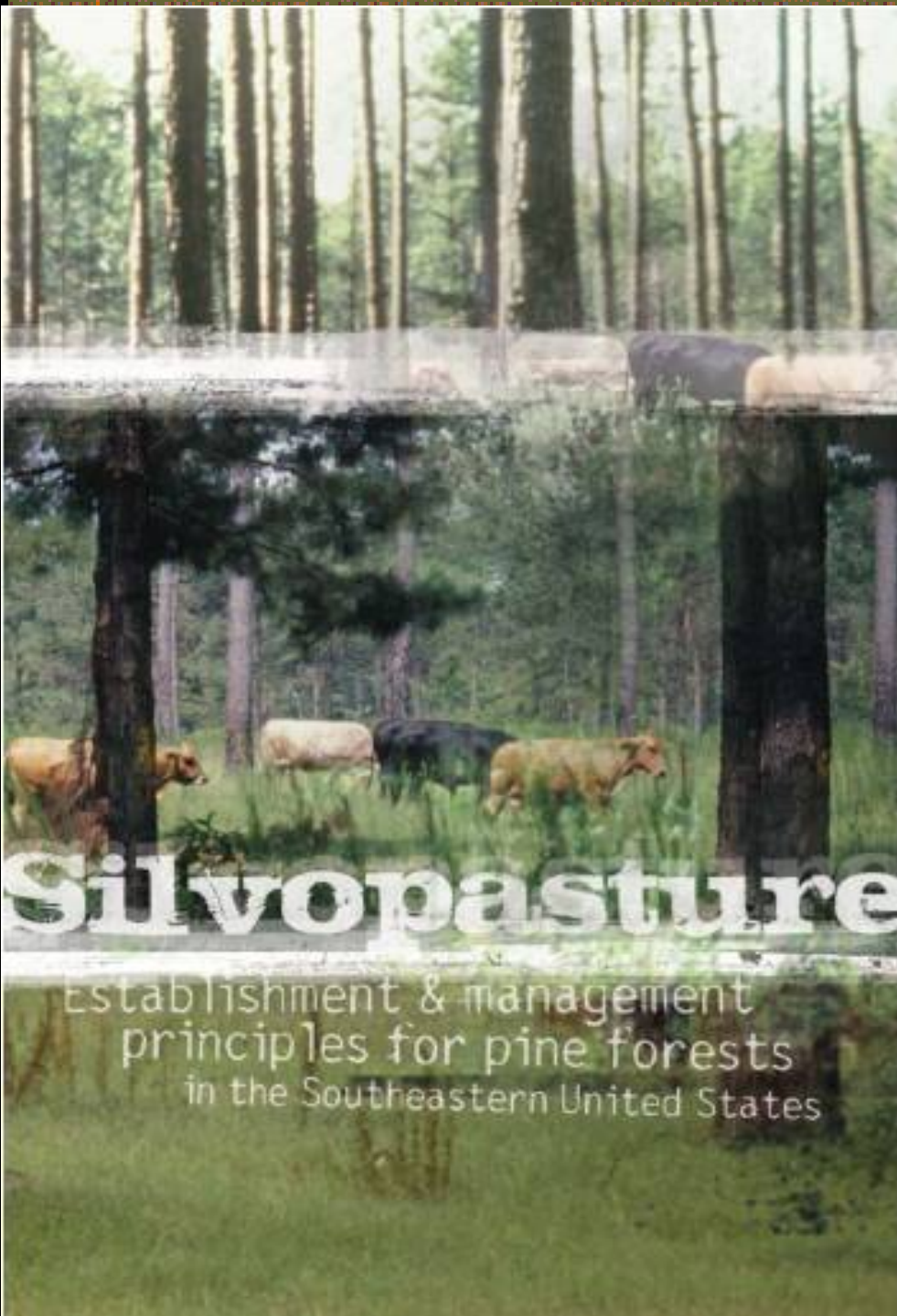
increases the comfort level for livestock which reduces stress.

The structure and plant diversity of silvopastures is attractive to many wildlife species including wild turkey, quail, deer, and many songbirds.

Silvopastures are inherently sustainable systems. They increase biological diversity, protect water quality, reduce soil erosion, and improve the water holding capacity of the soil.

Other benefits include natural insect control, opportunities for recreational activities like hunting and birdwatching, and enhanced aesthetics and property values.

Silvopasture is becoming an important land-management strategy on many farms and ranches in the southeastern United States. It is becoming more important on farms and ranches where coniferous trees exist in other parts of the country as well.



2008 - NEW Silvopasture Guidebook for Southeast

Editor: Jim Hamilton, Ph.D.
Forestry Program Coordinator
Haywood Community College
Natural Resources Management
Clyde, NC

QUESTIONS?



QUESTIONS?







North – South Row

More sun to the ground?

