What is Silvopasture?

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Agroforestry Practices

- Wind breaks
- Forest farming
- Riparian buffer strips
- Silvopastures
- Alley cropping
Silvopasture isn’t new
Silvopasture is NOT turning cows loose in the forest.
...nor a solo tree in a pasture
Silvopasture = Opportunity

• Sustainable practice
• Intensive, integrated management
  - Trees / Forages / Livestock
• Two economic scales/time frames
Why “Do” Silvopasture?

- Increased forage production
- Improved forage nutritive value
- Improved animal performance
- Production of additional products
- Increased biodiversity
- Greater soil fertility
- Reduced soil erosion
- Improved stream quality
Resources in silvopastures

Light

Soil nutrients

Moisture

Nutrient returns
Light

- $C_3$ leaves: light saturated at 50% full sun
- Leaf growth (at expense of roots) for grasses under reduced light
- Diffuse light used more efficiently than direct beam
- Light quality/quantity differ by tree species
Temporal partitioning

Relative Seasonal Growth, %

C-S grass

W-S tree
Diurnal soil surface temperature averaged within months in response to tree density in 2003
Temp effects on digestibility

- Yield: positive relation to temp & light
- Digestibility: declines with increased temperature

<table>
<thead>
<tr>
<th>Grass</th>
<th>35/24</th>
<th>32/21</th>
<th>29/18</th>
<th>26/15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digestibility, %</td>
<td>72</td>
<td>75</td>
<td>77</td>
<td>79</td>
</tr>
<tr>
<td>Bermuda</td>
<td>81</td>
<td>83</td>
<td>84</td>
<td>86</td>
</tr>
</tbody>
</table>

Day/Night Temperature, °C
Moisture

- Deciduous silvopastures: often no soil moisture differences
- Tree shade can reduce evapotranspiration losses
- Response likely varies across the range of soil, site conditions and tree species
two crops competing for the same resources (light, water, nutrients) can more efficiently exploit those resources than a single species.

COMPETITIVE PARTITIONING

Temporal Partitioning

Exclusive Access

Separate Sources
System output implications?
Forage Production

-TN '39: Increased carrying capacity with BW, HL
-OH '42: Greater yield, better forages with BW, BL
-VA '05: Young BW, HL trees ...

![Graph showing forage production across different tree densities and years](image-url)
Forage nutritive value

- Greater mineral concentrations
  (Krueger, 1981; Myers and Robbins, 1991; Buergler et al., 2006)
- Greater CP
  (Smith, 1942; Wilson, 1996)
- Reduced or unchanged NDF
  (Kephart and Buxton, 1993; Buergler et al., 2006)
- Reduced non-structural carbohydrate
  (Belesky, 2004; Buergler et al., 2006)
- Fiber digestibility? - may offset NSC
Livestock production
## Livestock production w/ shade

### Average daily gain (lb) - 4 year summary

<table>
<thead>
<tr>
<th></th>
<th>Natural shade</th>
<th>Artificial shade</th>
<th>No shade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cows</strong></td>
<td>1.28**</td>
<td>0.84</td>
<td>-0.04</td>
</tr>
<tr>
<td><strong>Calves</strong></td>
<td>1.85**</td>
<td>1.78*</td>
<td>1.17</td>
</tr>
</tbody>
</table>

* P<0.05 when compared to no shade
**P<0.01 when compared to no shade

McDaniel and Roark, 1956
Annual ryegrass in a pine-walnut system

- Reduced seasonal forage yield (20%)
- Forage of greater nutritive value
- No difference in animal gain
Even if all relationships are “negative competitive”, silvopastures can be more productive than open pasture
What about conservation functions?
## Virginia impaired waters

### 2012 Assessed Areas

<table>
<thead>
<tr>
<th>Waterbody Type</th>
<th>Total</th>
<th>Assessed</th>
<th>Attained Use</th>
<th>Impaired&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rivers (miles)</td>
<td>52,255</td>
<td>18,492</td>
<td>5,347</td>
<td>13,145 (71% of assessed)</td>
</tr>
<tr>
<td>Lakes (acres)</td>
<td>116,364</td>
<td>113,678</td>
<td>19,638</td>
<td>94,041 (83% of assessed)</td>
</tr>
<tr>
<td>Estuaries (sq. miles)</td>
<td>2,684</td>
<td>2,268 (85% of total)</td>
<td>139 (6% of assessed)</td>
<td>2,129 (94% of assessed)</td>
</tr>
</tbody>
</table>

<sup>1</sup> "Impaired" applies to both EPA Assessment Categories 4 and 5

*Note: Size adjustments using high resolution hydrography data account for discrepancies from prior cycle.*
Is fence the complete solution for this problem?

Fences don’t solve fescue toxicosis

Nontoxic

Toxic

Replacing TF often not an option
Management considerations for establishing silvopastures

What are the existing resources?

- Environment/Climate
- Tree species: thinning or planting
- Forages and Livestock
- Markets
- Producer ability and management goals
- Social / economic constraints
Thinning vs. planting

Eastern Red Cedar: Challenge or Opportunity?

Larger trees (still require mgmt)
Have to work with what you have

Renovation opportunity
Tree selection, nutrient input ?s

Takes time to reach size
Can choose species, configuration

Protection may be required
 Doesn't have to be fancy

Pine       Walnut       Pine

Elec. fence, cages, tubes
Thinning trees - selection criteria

1) market demand (both thinned/“leave” trees)
2) marketable size and timber quality
3) epicormic branching issues
4) invasive? (ailanthus, autumn olive)
5) level of shading (e.g., maples)
6) spatial constraints or infrastructural needs
7) soil compaction
8) labor required

Resource advisors - knowledgeable, collaborative
Companion forages

Grasses
• VA: The usual suspects
  - Arkansas pine data: orchardgrass > fescue
  - Va walnuts: fescue better adapted
• Deep South: W-S grasses okay with pine

Legumes
• Shade tolerance may be an issue
• Clovers, alfalfa sensitive to juglone (walnuts)
Planting trees - selection criteria

1) marketable timber
2) high-quality wood
3) rapid growth
4) deep-rooted morphology
5) drought tolerance
6) additional products (nuts, fodder) and livestock compatibility
7) provision of environmental conservation services
8) labor required
9) rotation length - fxn of:
   1) Producer goals
   2) Land tenure needs/constraints
Planting trees also allows control of spatial arrangement: Rows, spacing, orientation
Planting trees - a few possible species

- Fruit trees - apple, cherry, pear, etc.
- Nut trees - walnut*, pecan*, hickory*, American chestnut?
- Locusts*: black†, honey
- Yellow poplar (moderate shade)
- Oaks - white, northern red (high shade)
- Maple (high shade)
- Pines: Loblolly, Long-or Short-leaf, White

*“Warm-season” tree
†Biological N fixers
Match trees to conditions, needs

Select for site suitability
Rapid growth?
Market value
Multiple products: fruits, nuts, browse

Double row pine

Pine straw

Honeylocust

Fruit/nut orchard

Am. chestnut

Pine straw
Livestock-tree compatibility

Tender, palatable trees need protection
- Cows more likely to trample
- Small ruminants more likely to nibble
- Are wildlife a problem?
- Can site be hayed till trees big enough?

'Millwood' honeylocust
Protection methods
Silvopasture management

...requires shifting our thinking in both spatial and temporal domains and demands skills in managing [complexity] rather than reducing complexity...

Garrett et al., '04
Silvopasture management...requires shifting our thinking in both spatial and temporal domains and demands skills in managing [complexity] rather than reducing complexity... Garrett et al., ’04
Trees with pastures can be great Natural Resources, providing greater goods and Conservation Services in livestock systems.
Thanks!
jhf@vt.edu
High Yielding Tree

Low Yielding Tree
Fifty-two cows are killed after lightning hits a wire fence.

Photo credit: Kelli Easterling | Richmond County Daily Journal
Used with permission

http://www.telegraph.co.uk/news/worldnews/southamerica/3249895/Fifty-two-cows-are-killed-after-lightning-hits-a-wire-fence.html

http://www.lightningsafety.noaa.gov/science/science_ground_currents.htm
Eastern Red Cedar: Challenge?
Or Opportunity?