Silvopasture Ecosystem Services

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A farm can be regarded as a food factory and the criterion for its success is saleable products.

or

It can be regarded as a place to live, and the criterion for its success is harmonious balance between plants, animals and people; between the domestic and the wild; and between utility and beauty – Aldo Leopold
All Agroforestry practices provide ecosystem services.
4 year old RFB

Native Grass

Shrubs

Trees
The Question Is?

How does silvopasture management affect:
1. Soil features
2. Water quality
3. Air quality

Or Does It?
*Do not use continuous grazing*

Rotational Grazing is essential for successful Silvopasture Practices!
One consequence of continuous grazing is a reduction in forage root length and surface area.
Buffering Grazed Paddocks
AgB Treatment
GB
Treatment
A comparison of a tree/grass and a grass buffer root system

Root length (ft/ft³)

Root surface area (ft²/ft³)
Soil Properties and Pore Characteristics as Influenced by Grass and Agroforestry Buffers
Typical scan images 2.7 inches diam. area

After thresholding, air-filled pores are in red

Isolated pores within the scans

Udawatta et al., 2006
CONCLUSIONS

Results of this study show that agroforestry and grass buffers improve soil physical properties such as bulk density, hydraulic conductivity, and CT-measured pore parameters. Because of this, adoption should reduce runoff, nutrient, and sediment loss and improve water quality.
### Agroforestry Environmental Services

- **Agroforestry Buffer Technologies**

<table>
<thead>
<tr>
<th>Reduction in:</th>
<th>Agroforestry</th>
<th>Grass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>48%</td>
<td>23%</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>75%</td>
<td>68%</td>
</tr>
<tr>
<td>Total Phosphorous</td>
<td>70%</td>
<td>67%</td>
</tr>
</tbody>
</table>

- **Agroforestry Buffer**
- **Grass Buffer**
Approximate study site location in Missouri and 0.5 m (1.6-foot) interval contour lines on watersheds. Gray bands represent location of contour grass buffers on contour strip watershed, agroforestry buffers on agroforestry watershed and grass waterways on all three watersheds.
At 5000 feet Elevation
In 2002
Results to date:

agroforestry and contour strips significantly reduce runoff, sediment, total phosphorus, and total nitrogen loss from corn-soybean rotation watersheds.
Water Quality and Livestock

Rhizodegradation of Antibiotics
Rhizodegradation of antibiotics and herbicides by selected plant species

- Oxytetracycline
- Sulfadimethoxine
- Enrofloxacin
Use of Veterinary Antibiotics

- 24 to 35 million lb antibiotics used in US and 70% for non-therapeutic purposes (Levy, 1998; Mellon, 2001)
- 30 – 80% of an antibiotic dose can pass through the GI tract (Elmund, et al., 1971; Levy, 1992)
Veterinary Antibiotics in Manure

- Manure is applied to croplands to enhance soil fertility, subsequently, antibiotics are co-applied.
- Most manure is disposed of on lands within 50 mi of facility (Sharpley et al., 1993; Pelletier et al., 2001).
Veterinary Antibiotics - Concerns

- Increased development and spread of antibiotic resistant bacteria
- Change in the structure or diversity of microbial communities in soil or water resources
- Diminished water quality and undetermined health effects associated with long-term consumption of antibiotics
Commonly Used Veterinary Antibiotics

- 47.5% Ionophores/Arsenicals
- 28.9% Other Antibiotics*
  - Cephalosporins
  - Macrolides
  - Lincosamides
  - Polypeptides
  - Streptogramins
- 15.8% Tetracyclines
- 4.3% Penicillins
- 0.2% Fluoroquinolones
- 1.2% Aminoglycosides

*Other Antibiotics

Data from AHI (1999) as reported by Samarah et al. (2006)
Degradation of Veterinary Antibiotics
*(sulfamethazine)*

**Agroforestry Environmental Services**
- **Agroforestry Buffer Technologies**

**Fluorescein diacetate hydrolytic (FDA)**

**Glucosaminidase (GLA)**

**β-glucosidase (GLU)**
Carbon Sequestration

Tree Roots
1. Depth
2. Volume
3. Carbon form (recalcitrant)
4. Root exudates (leaching)
5. Root Turnover (33% NPP fine root)

6. Associated microbial communities
   C, exudates, turnover
Is Silvopasture Management a Viable Option for Carbon Sequestration?

Table 2.2 – estimated potential annual carbon sequestration for selected changes in land use and production practices in U.S. agriculture (USDA Tech. Bul. TB-1909).

<table>
<thead>
<tr>
<th>Land-use change or management practice</th>
<th>Estimated per acre sequestration</th>
<th>Total potential sequestration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing land:</td>
<td>Mt per acre</td>
<td>MMT</td>
</tr>
<tr>
<td>Afforestation of pasture</td>
<td>0.73 - 2.09</td>
<td>8 - 22</td>
</tr>
<tr>
<td>Rangeland management</td>
<td>0.05 - 0.15</td>
<td>5 - 16</td>
</tr>
<tr>
<td>Pasture management:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Improved use of fertilizers</td>
<td>0.10 - 0.20</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Use of organic manure</td>
<td>0.20 - 0.50</td>
<td>3 - 9</td>
</tr>
<tr>
<td>Planting of improved species</td>
<td>0.10 - 0.30</td>
<td>1 - 3</td>
</tr>
<tr>
<td>Grazing management</td>
<td>0.30 - 1.30</td>
<td>5 - 20</td>
</tr>
</tbody>
</table>
Silvopasture for Carbon Sequestration

Tufekcioglu et al., 2003

![Image of silvopasture field]

![Bar chart showing carbon sequestration by plant type](chart.png)

- **Poplar**
- **Switchgrass**
- **Cool-Season Grass**
- **Corn**
- **Soybean**

Tufekcioglu et al., 2003
Thank you!

QUESTIONS?