Silvopasture Ecosystem Services

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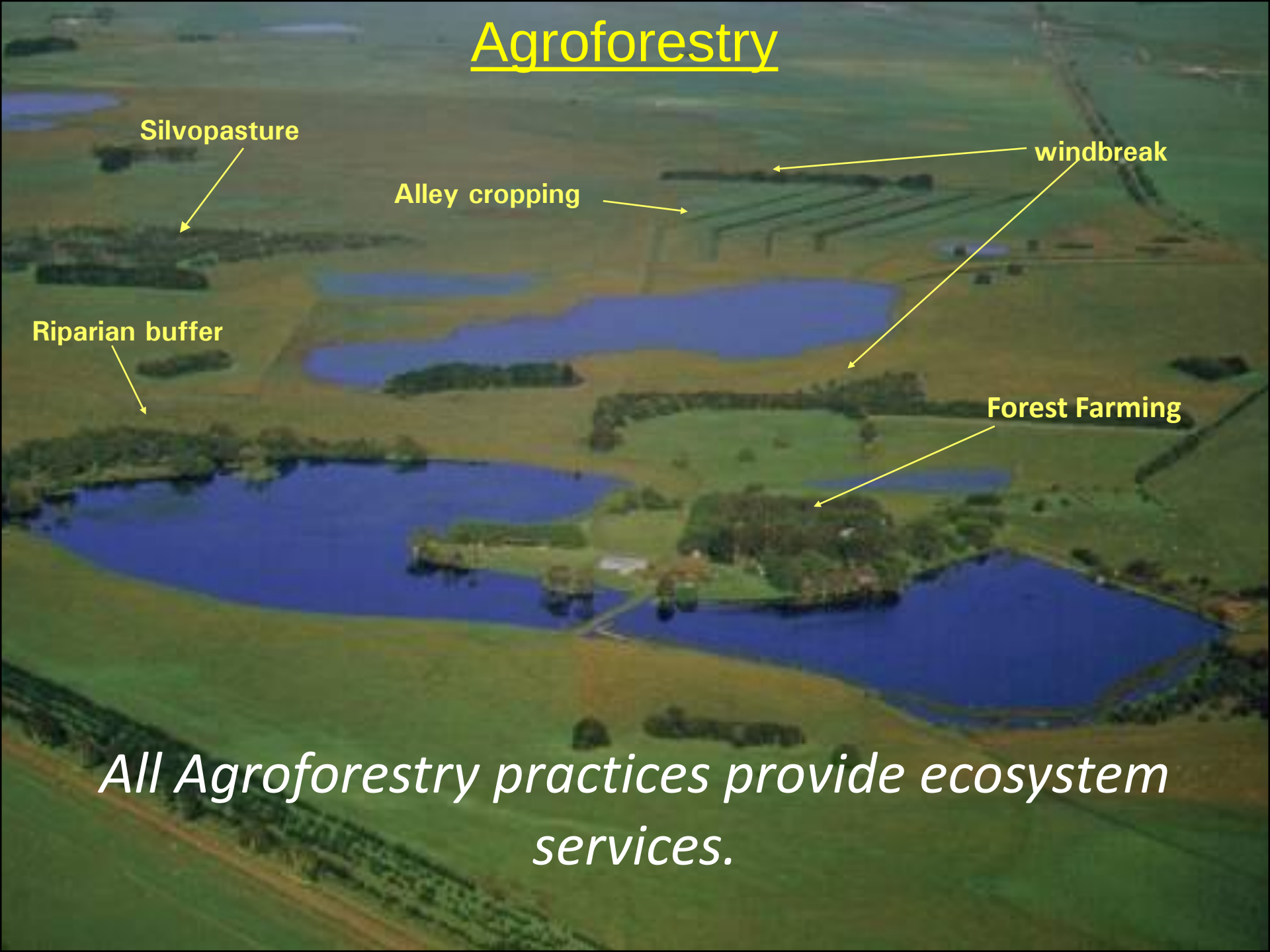
A farm can be regarded as a food factory and the criterion for its success is saleable products.

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*

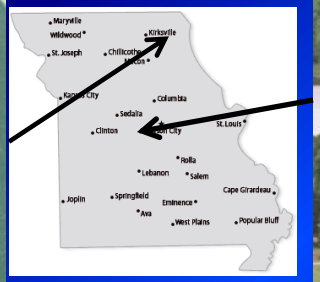
Agroforestry



All Agroforestry practices provide ecosystem services.


4 year old RFB
Native
Grass
Shrubs
Trees

Paired watershed at Greenley Center



Grazed Pasture watersheds at HARC

The Question Is ?

How does silvopasture management affect:

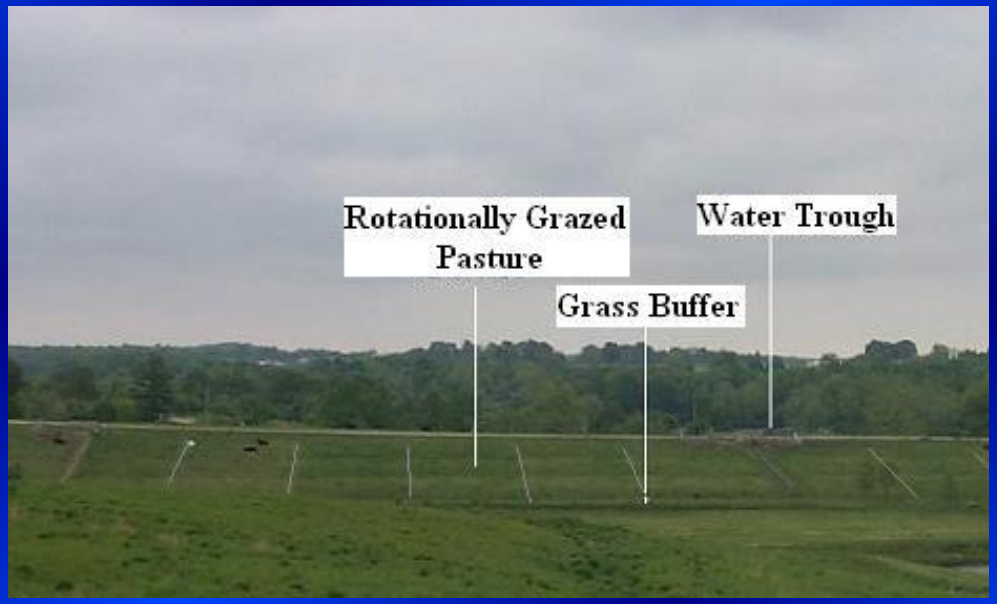
1. Soil features
2. Water quality
3. Air quality

Or Does It ?

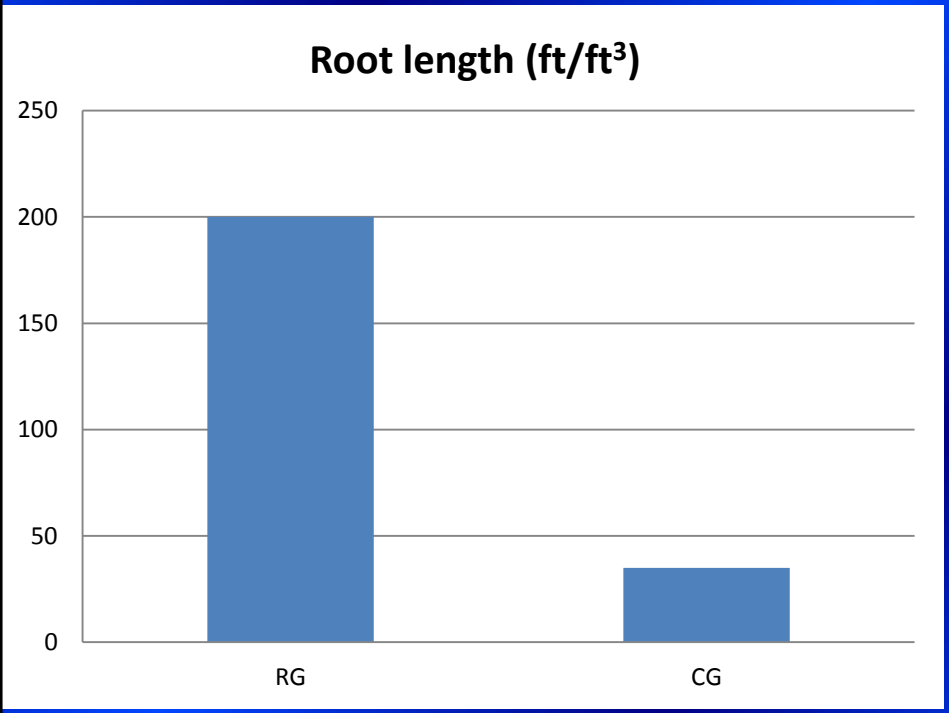
Major Take-home Point

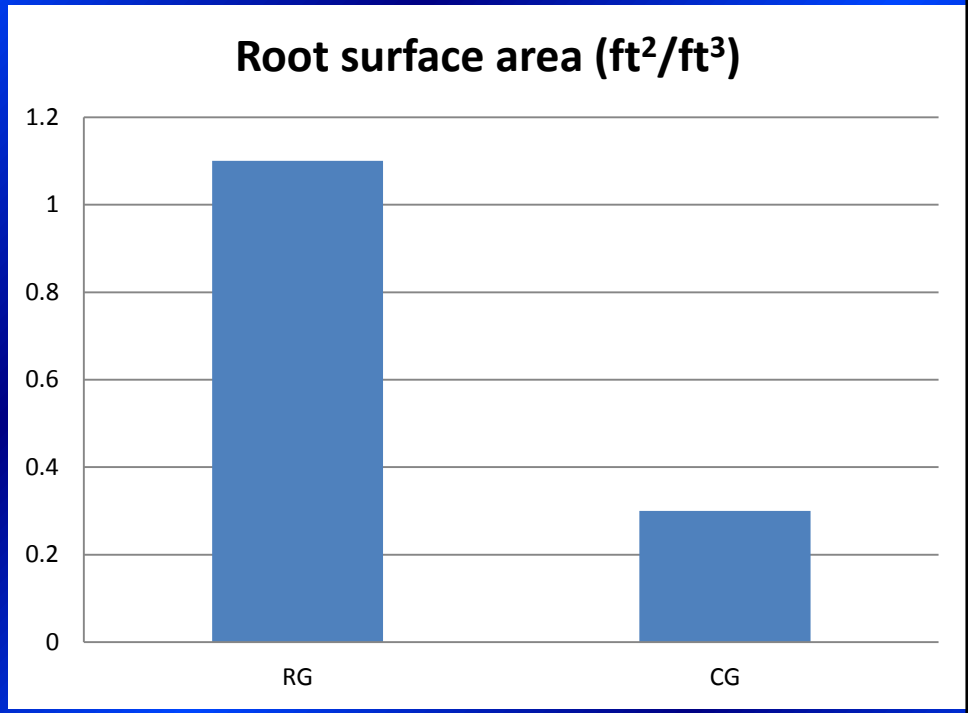
* *Do not* use continuous grazing

Rotational Grazing - - essential for successful Silvopasture Practices!



One consequence of continuous grazing is a reduction in forage root length and surface area



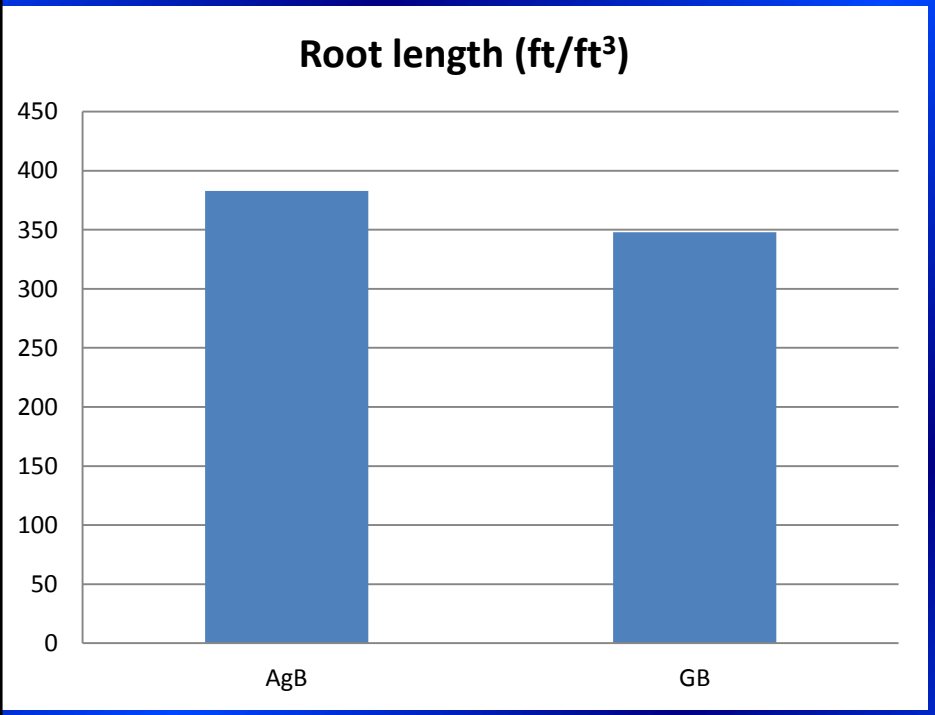


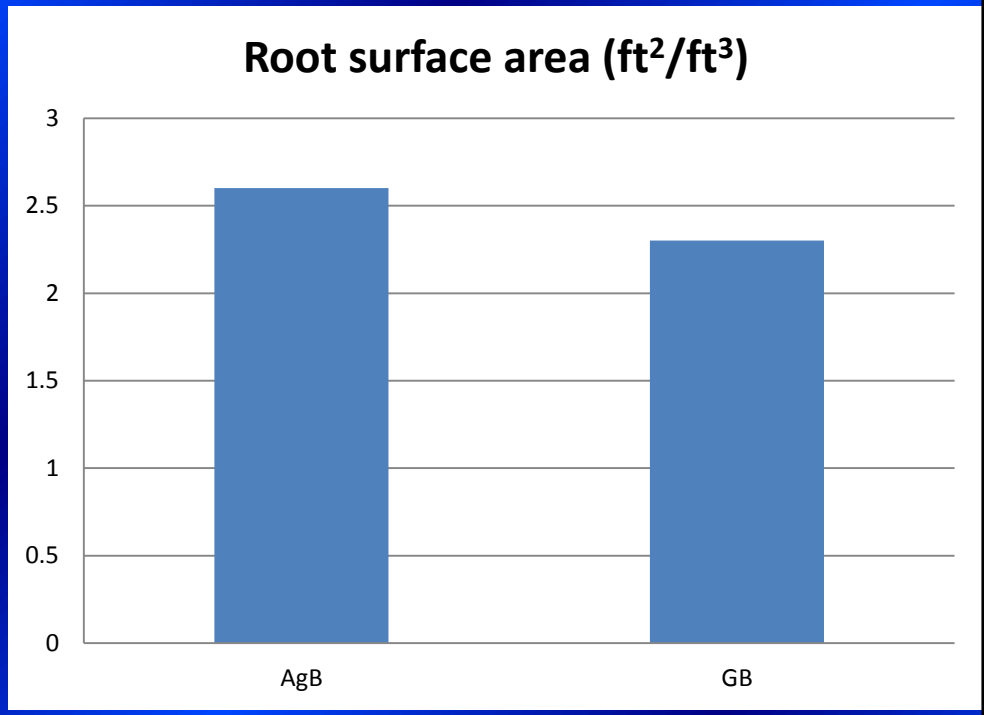
Buffering Grazed Paddocks

AgB Treatment


GB
Treatment

A comparison of a tree/grass and a grass buffer root system





Soil Properties and Pore Characteristics as Influenced by Grass and Agroforestry Buffers

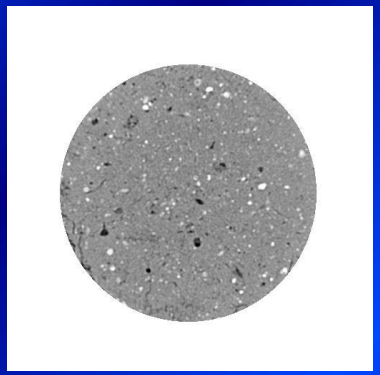

SIEMENS
APR 16 2006

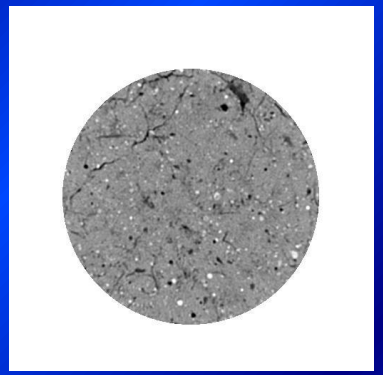
Row crop

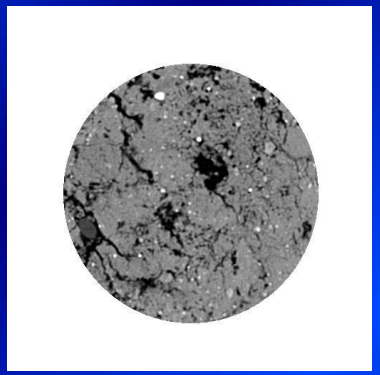
Grass buffer

Agroforestry

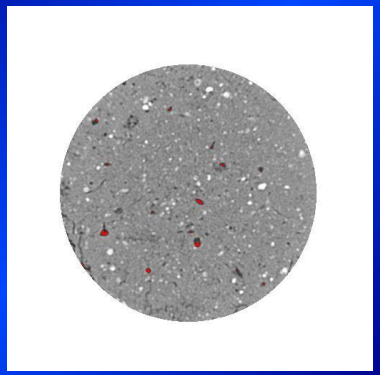
Typical scan images 2.7 inches diam. area

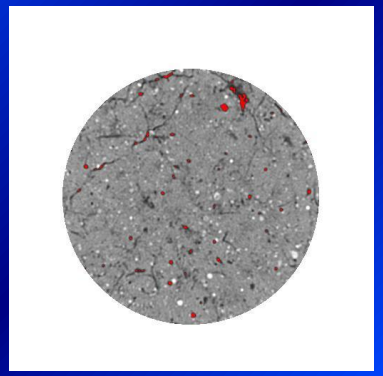


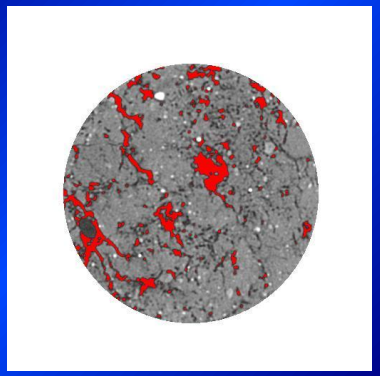




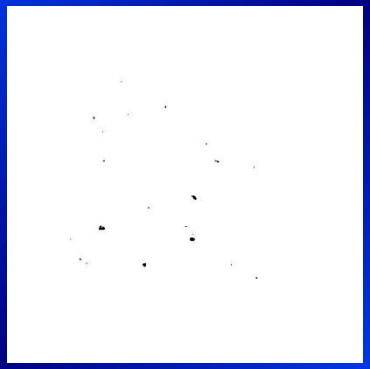
After thresholding, air-filled pores are in red

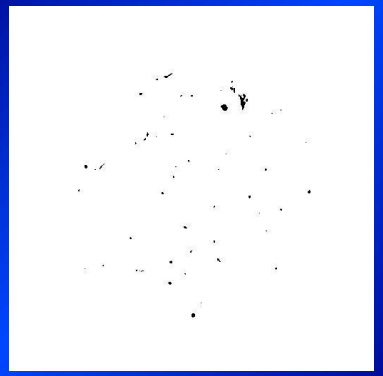


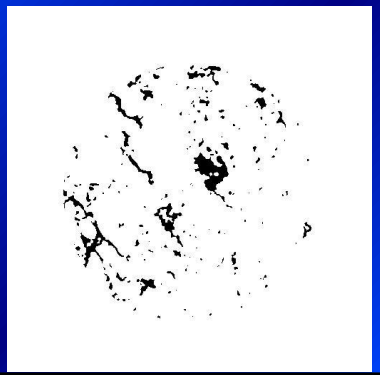




Isolated pores within the scans







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.

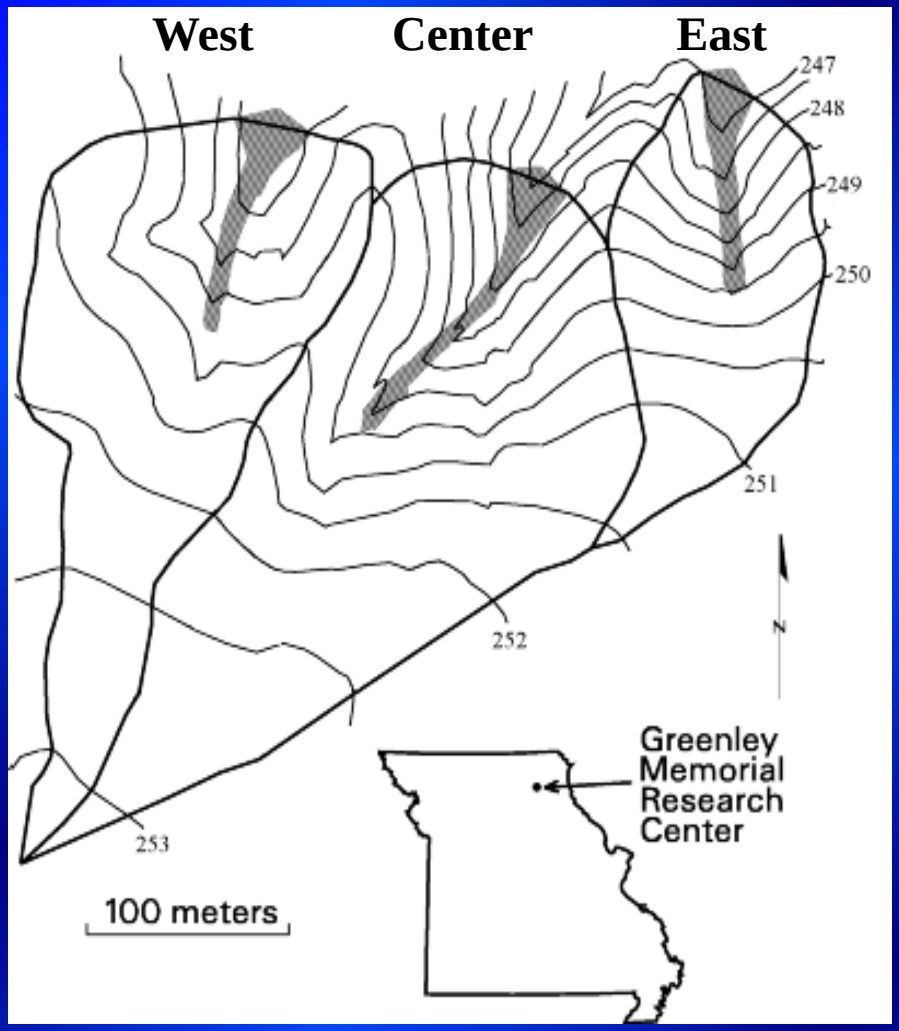
Agroforestry Environmental Services

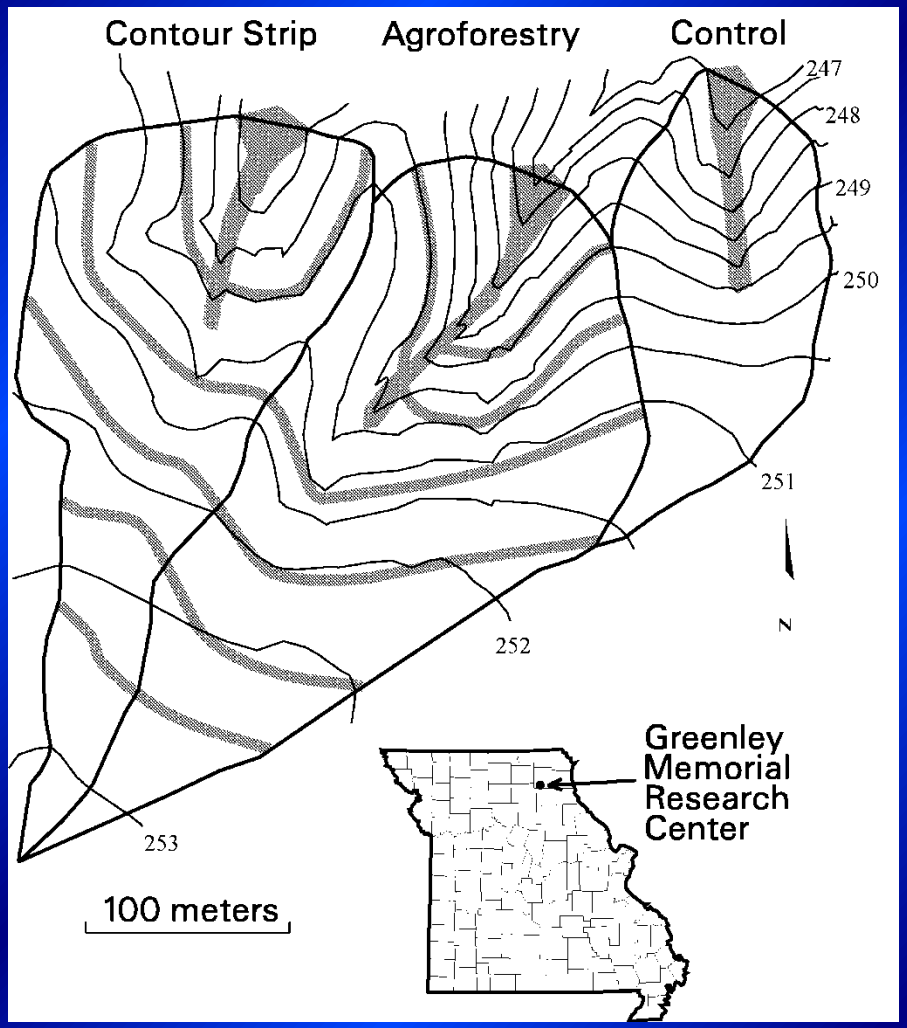
- Agroforestry Buffer Technologies -

Reduction in:	Agroforestry	Grass
Sediment	48%	23%
Total Nitrogen	75%	68%
Total Phosphorous	70%	67%

Agroforestry Buffer

Grass Buffer





1991-1997

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.

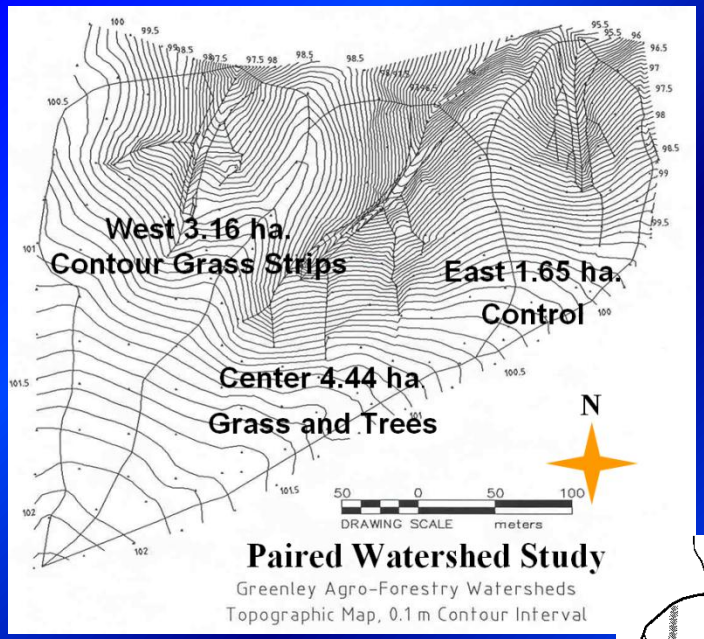
At 5000 feet Elevation In 2002


1997


2003


2005

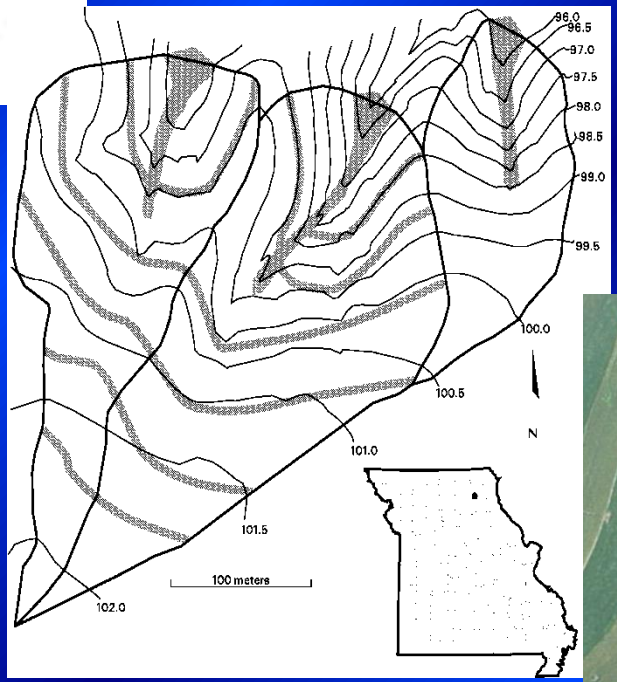

2007

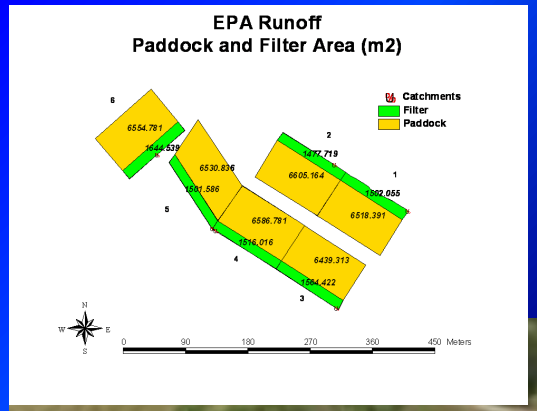


Results to date:

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

Paired watershed study





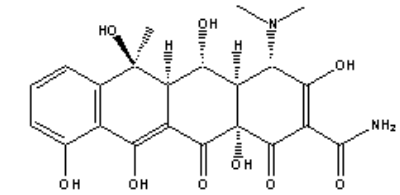
Water Quality and Livestock

Rhizodegradation of Antibiotics

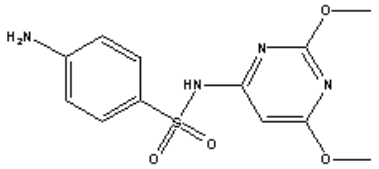
Poplar Buffer

Grass Buffer

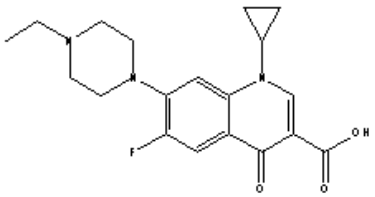
Rhizodegradation of antibiotics and herbicides by selected plant species



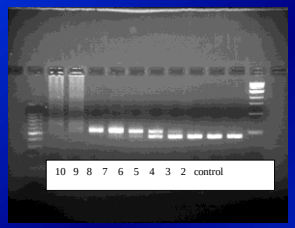
oxytetracycline

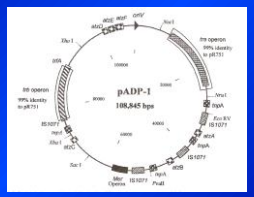


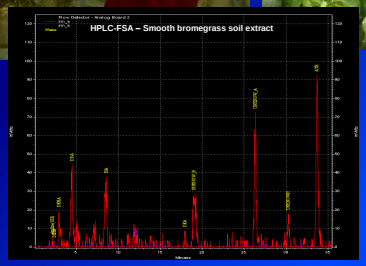
sulfadimethoxine

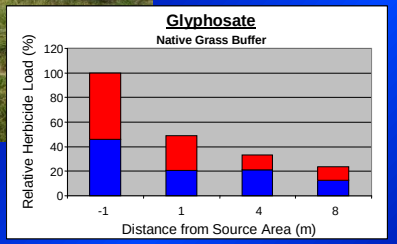


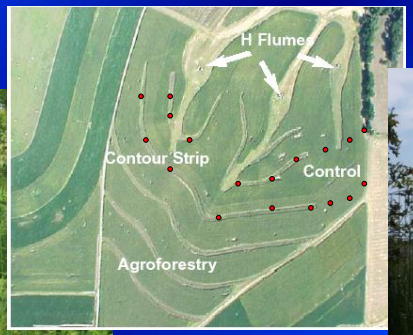
enrofloxacin


10 9 8 7 6 5 4 3 2 control


pADP-1
108,845 bps


HPLC-FSA – Smooth bromegrass soil extract


Glyphosate
Native Grass Buffer
Relative Herbicide Load (%)
120
100
80
60
40
20
0
-1
1
4
8
Distance from Source Area (m)


H Flumes
Contour Strip
Control
Agroforestry

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)

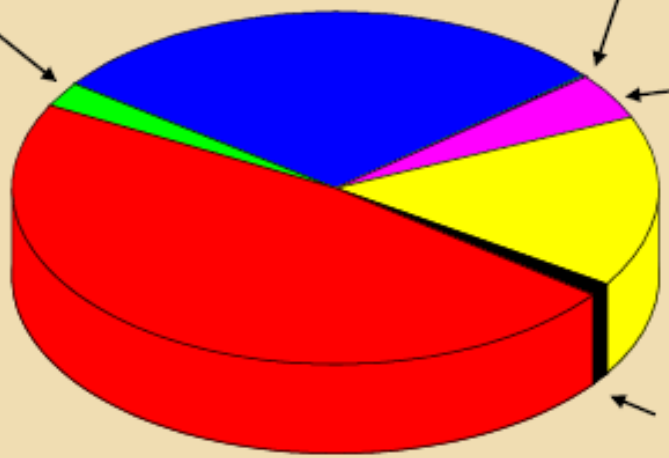
Veterinary Antibiotics in Manure

- 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



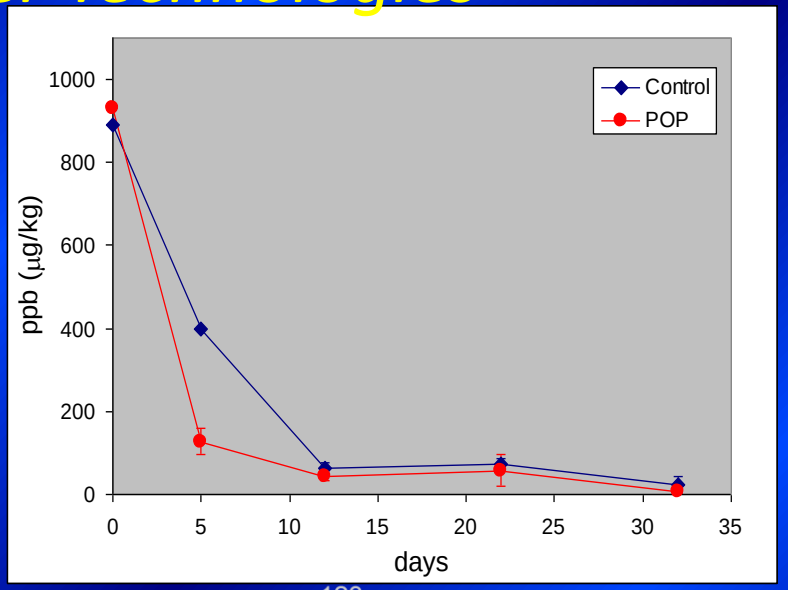
*Other Antibiotics
Cephalosporins
Macrolides
Lincosamides
Polypeptides
Streptogramins

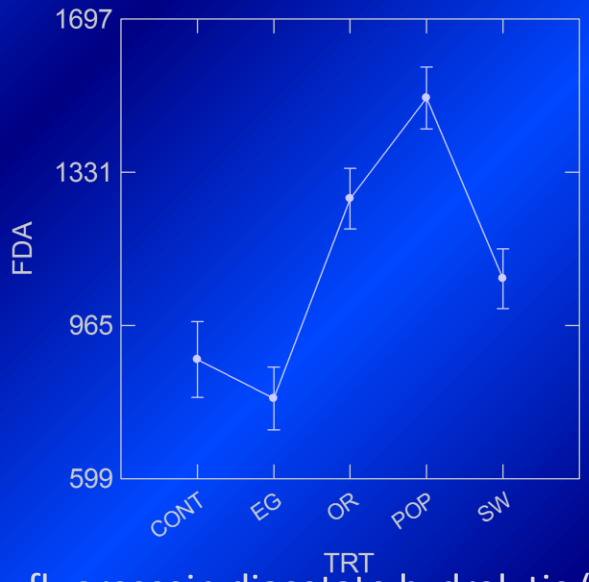
Data from AHI (1999) as reported by Samarah et al. (2006)

Agroforestry Environmental Services

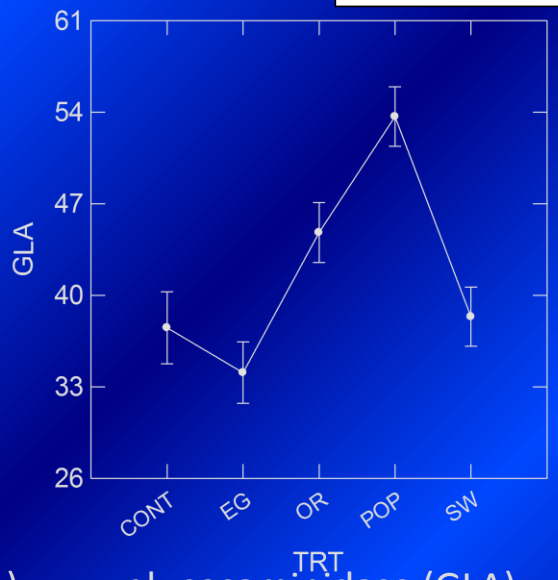
- Agroforestry Buffer Technologies -

Degradation of Veterinary Antibiotics
(*sulfamethazine*)

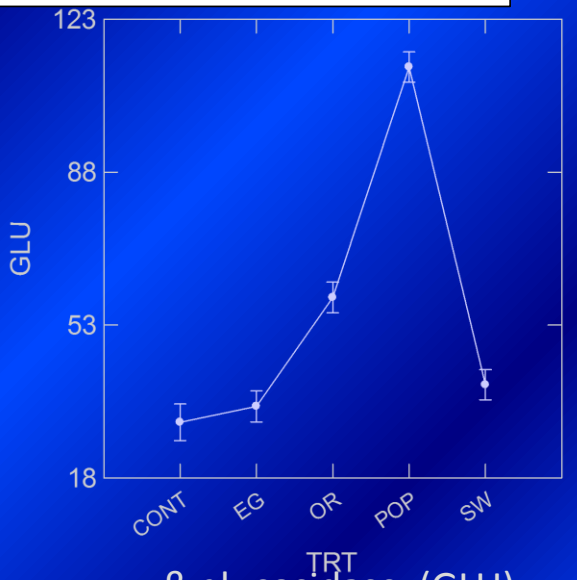




fluorescein diacetate hydrolytic (FDA)



glucosaminidase (GLA)



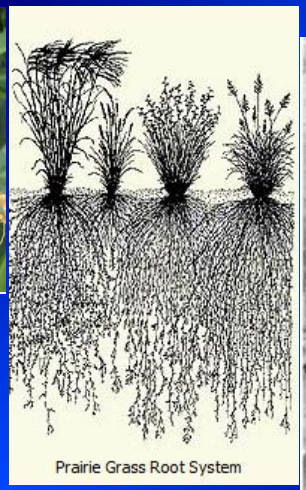
β-glucosidase (GLU)

Carbon Sequestration

Corn

Soybean

Grass



Prairie Grass Root System

Tree Roots

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

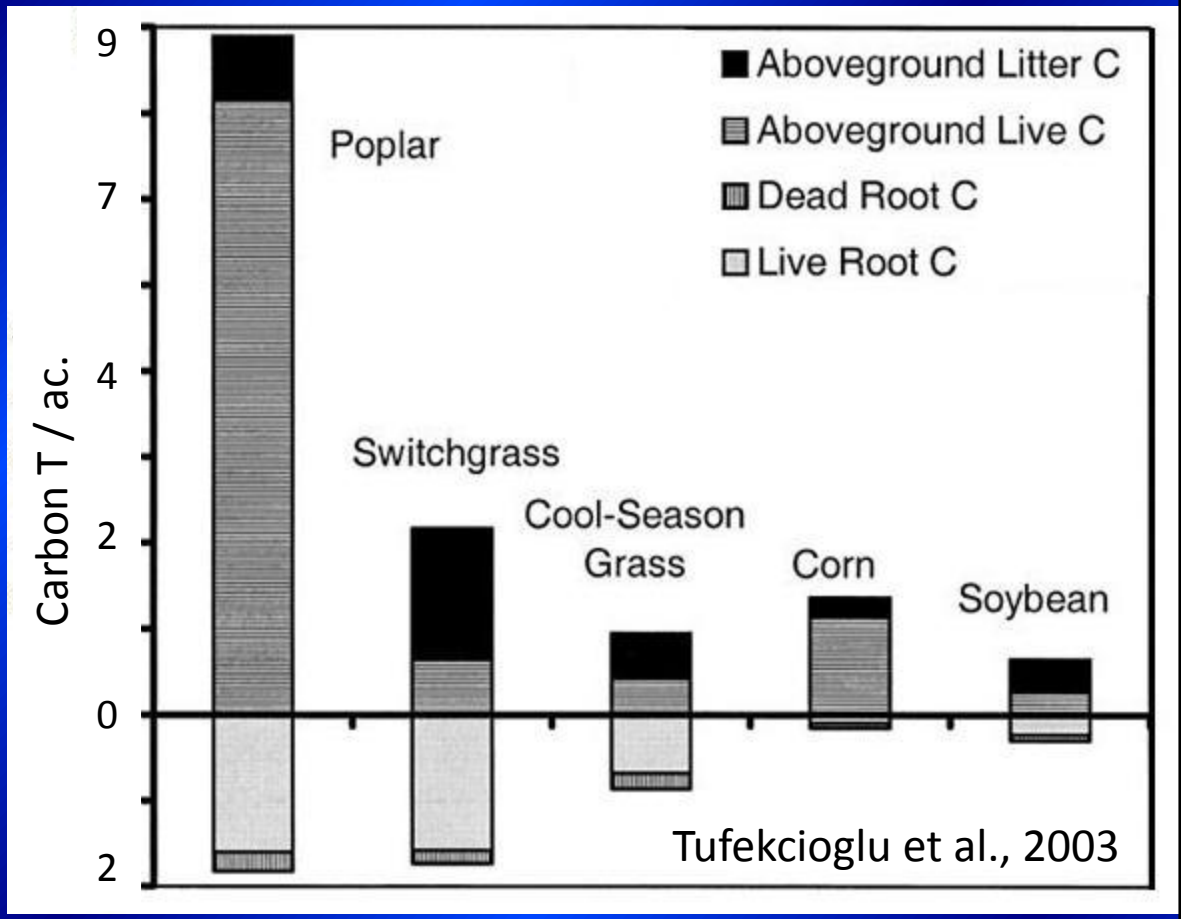
6. Associated microbial communities
   C, exudates, turnover

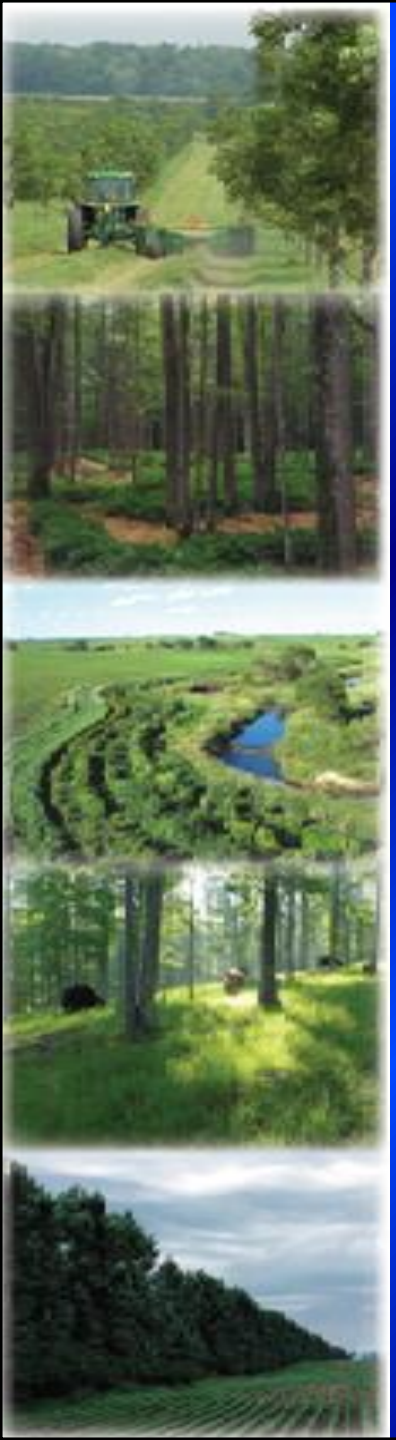
Is Silvopasture Management a Viable Option for Carbon Sequestration?

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).

Land-use change or management practice	Estimated per acre sequestration	Total potential sequestration
	Mt per acre	*MMT*
Grazing land:		
Afforestation of pasture	0.73 - 2.09	8 - 22
Rangeland management	0.05 - 0.15	5 - 16
Pasture management:		
Improved use of fertilizers	0.10 - 0.20	2 - 4
Use of organic manure	0.20 - 0.50	3 - 9
Planting of improved species	0.10 - 0.30	1 - 3
Grazing management	0.30 - 1.30	5 - 20

Silvopasture for Carbon Sequestration





Thank you!

QUESTIONS?

The Center for Agroforestry
University of Missouri

A Global Center for Agroforestry, Entrepreneurship and the Environment