Agroforestry – Tools for Transforming Farms

Richard Straight, USDA National Agroforestry Center
My Agenda For This Morning

• USDA National Agroforestry Center
• Agroforestry
• Climate Change and Agroforestry
• Biodiversity and Agroforestry
• Cute picture at the end of the presentation
USDA National Agroforestry Center

- Enhance benefits of agroforestry;
- Accelerate agroforestry adoption.

US Forest Service (Research and Development, and State and Private forestry) and the Natural Resources Conservation Service
USDA National Agroforestry Center

- Based at the University of Nebraska at Lincoln
- Technology Transfer
  - Technical publications
  - Training and demonstration
  - Regional networks
- Research
  - Models and tools for efficient design
What is Agroforestry?

Intentional integration of trees with agriculture to:

- Provide environmental, economic and social benefits; and
- Support productive, sustainable farms, ranches, and woodlands;
Most Common Agroforestry Systems (U.S.)

- Windbreaks/Shelterbelts
- Riparian Forest Buffers
- Silvopasture
- Alley Cropping
- Multi-story cropping (Forest Farming)
Windbreaks
Riparian Forest buffers
Silvopasture
Alley cropping
Forest farming
From agricultural lands:

We want it all.
To provide for a growing population: We will want more of it all.
Realizing Agriculture’s Potential?

CLIMATE CHANGE
- Temperature Change
- Precipitation Change
- Sea Level Rise
- Extreme/Erratic Weather Events
- Carbon Dioxide
Many Actions for Building Climate-Ready Agriculture

- Conservation tillage
- Crop rotations
- Crop species
- Irrigation management
- Fertilization (type, timing, placement)
- Grazing (species, rotations)
- Cover crops
- Perennial crops
- Eliminate fallow
- Converting (i.e., cropland to pasture)

Agroforestry: providing ReLeaf to Ag
Agroforestry: one strategy with multiple services

- Diversity of income
- Crop protection & enhancement
- Livestock protection
- Pollinator services
- Biological pest control

- Protection of soil resources
- Water & air quality
- Wildlife habitat
- Recreational opportunities
- Aesthetics

....the right trees in the right places for the right jobs. 
Agroforestry: A ‘Leatherman’ w/in the ‘CC-Integrated’ Toolbox for Agriculture

Mitigation
- Sequestering carbon (C)
- Reducing GHG emissions

Adaptation
- Reducing threats & enhancing resilience
- Facilitating species migration

... While providing other services

Branching Out: Agroforestry as a Climate Change Mitigation & Adaptation Tool for Agriculture. JSWC (2012)
## Carbon Sequestration Potential – 2 Options

Mead Farm – Nebraska (50 years)

<table>
<thead>
<tr>
<th>Option</th>
<th>Ha</th>
<th>%total</th>
<th>MT CO₂</th>
<th>MT CO₂/ha/yr</th>
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*COMeT-VR (Brenner et al.)

Schoeneberger, Brandle & Zhou
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Schoeneberger, Brandle & Zhou
COMET Farm - Carbon & Greenhouse Accounting System

What Is COMET-Farm?
COMET-Farm is a whole farm and ranch carbon and greenhouse gas accounting system. The tool guides you through describing your farm and ranch management practices including alternative future management options. Once complete, a report is generated comparing the carbon changes and greenhouse gas emissions between your current management practices and future scenarios.

Start Using COMET-Farm
COMET Farm - Carbon & Greenhouse Accounting System
COMET Farm - Carbon & Greenhouse Accounting System

1. Choose the main areas to investigate.
   - Cropland, Pasture
   - Livestock
   - On-Farm Energy

2. Describe the locations and management practices for the selected activities. Use these information to model future management scenarios to compare the current practices.

3. Run the report.

What information will I need to provide?
Agroforestry: A ‘Leatherman’ w/in the ‘CC-Integrated’ Toolbox for Agriculture

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Branching Out: Agroforestry as a Climate Change Mitigation & Adaptation Tool for Agriculture. JSWC (2012)
Risk management difficult in monocultures and annual-only systems.

Mixing in woody plants offers:
- Crop diversification
- Structural and functional diversity
Agroforestry: Reducing Threats & Enhancing Resiliency in Ag-Lands

🌿 Microclimate modification
🌿 Habitat diversification
🌿 Maintenance & protection of natural resource services
🌿 Diversified production opportunities
Yield increases due to wind protection (Kort 1988)
(average of 15% in winter wheat, 25% in soybeans, 12% in corn)

Higher grain yields in alley-grown wheat during drought compared to the control. (Rivest et al. 2013)
Air and soil temperatures too cold or too warm for forage growth can be favorably modified by silvopasture systems to create extended production. (Feldhake 2002; Moreno et al. 2007)

Higher levels of CO2 reduce forage quality. Shading may increase forage quality (increasing protein content while reducing fiber). (Morgan et al. 2004; Kallenbach et al. 2006)
Livestock shelterbelts increased feed efficiency 13-50% in winter and milk production by 9-76% (Hintz 1983)

Cattle provided with shade reached their target body weight 20 days earlier than those without shade. (Mitolhner et al. 2001)
Where Can I Find Climate Change Information?

Related to Farming
USDA Climate Hubs

• Develop and deliver science-based, region-specific information and technologies
• To agricultural and natural resource managers
• That enable climate-informed decision-making, and
• To provide access to assistance to implement those decisions.
USDA Climate Hubs

https://www.climatehubs.oce.usda.gov/
Southern Plains Climate Hub

Welcome to the USDA Southern Plains Climate Hub
The Southern Plains Climate Hub develops and delivers regional, science-based information to partners and producers in Kansas, Oklahoma, and Texas that enables climate-smart decision-making.

Popular Topics:
- Southern Plains Regional Vulnerability Assessment - En Español
- Southern Plains USDA Building Blocks Report
- Subscribe to ARS AgResearch
Biodiversity

- Different Scales
  - field
  - farm
  - watershed
- Intentionally
  - crop rotation
  - variety of crops
  - cover crops
  - windbreaks
  - leaving untilled areas
- Unintentional
  - stuff happens
Benefits of Encouraging Diversity:

• Improve soil quality
• Support insect, weed and disease control
• Encourage beneficial organisms
• Reduce economic risk
Components
- Pollinators
- Herbivores
- Earthworms
- Soil Microfauna
- Predators
- Parasites
- Noncrop Vegetables
- Soil Mesofauna

Functions
- Agroecosystem Biodiversity
- Biological Control
- Competition
- Allelopathy
- Decomposition
- Predation
- Pollination
- Biomass Consumption
- Soil Structure
- Disease Suppression

Altieri, 1991
Habitat diversification

- Agroforestry plantings can provide critical habitat to native pollinators, and
- Natural enemies to crop pests.
Many Agroforestry Practices Can Function as Corridors

Critical travel corridors in the highly fragmented ag/urban landscape.
Corridor Width Summary

- Plants
- Invertebrates
- Aquatic Species
- Reptiles & Amphibians
- Birds: Interior Species
- Birds: Edge Species
- Small Mammals
- Large Mammals
- Lg. Predator Mammals

Minimum recommended width
Upper end of recommended width

Source: Conservation Buffers – Design Guidelines for Buffers, Corridors and Greenways by Gary Bentrup
Habitat diversification: Connectivity

- Critical habitat for ‘every day’ survival in-place.
- Critical migration corridors to escape climate change-impaired habitat.
- Critical habitat to escape extreme weather event - FLOODS
## Agroforestry in the Farm Bill

<table>
<thead>
<tr>
<th></th>
<th>Alley Cropping</th>
<th>Riparian Forest Buffer</th>
<th>Windbreak</th>
<th>Silvopasture</th>
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**F = Financial Assistance**  
**S = Stewardship Payments**  
**R = Rental Payment**  
**I = Incentive Payment**  
**E = Easement**

*not all practices or programs are available in all states.*
Transforming Our Farms, Our Food and Our Future