

# **Sustainable Corn Stover Harvest Strategies for Midwest Agricultural Landscapes**

Presented at the Incorporating Bioenergy in Sustainable  
Landscape Designs Two: Agricultural Landscapes  
June 25, 2014

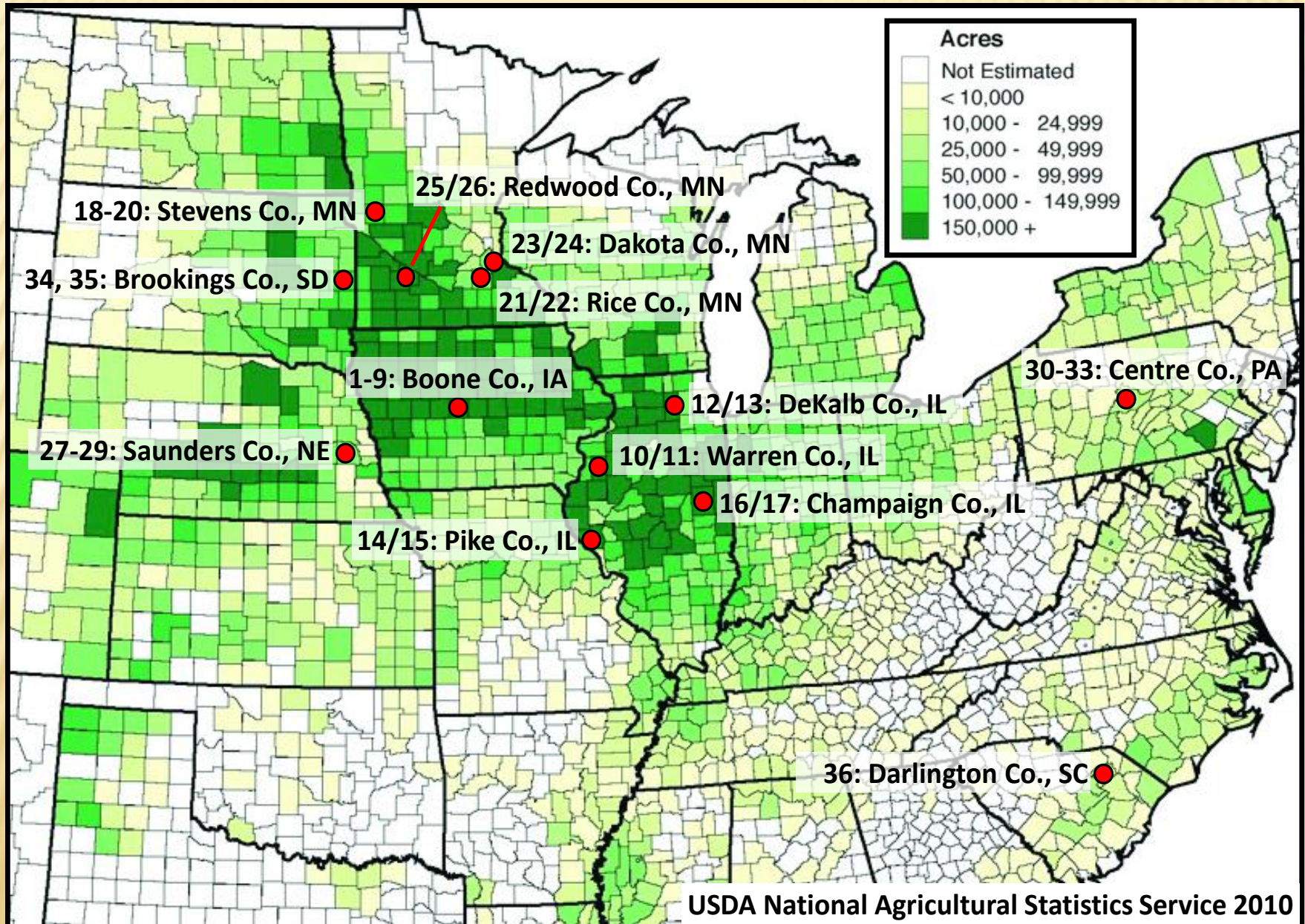
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# Presentation Overview

- An overview of the USDA-ARS REAP – DOE Regional Corn Stover – Sun Grant Partnership
- What has been learned regarding sustainable corn stover harvest?
- Landscape management strategies for increasing the quantity of corn stover that can be harvested in a sustainable manner



# REAP/Regional Partnership Sites





# Utilized Multiple Harvest Technologies



University Park



Lincoln



Ames, Morris & St. Paul



Florence



Industry Collaborators

# What has the REAP/Regional Partnership Done?

- Compiled 239 site-years of stover harvest data
  - Effects on subsequent grain and stover yields
  - Effects on soil organic carbon (C) & aggregation
  - Effects on microbial community
  - Effects on GHG emissions
- Prepared a special 2014 issue of BioEnergy Research
- Developed the **Landscape Environmental Assessment Framework (LEAF)** and other tools to:
  - Estimate available residue
  - Quantify economics
  - Ensure ecosystem service benefits are sustained

**This involved ARS, DOE, university, and private industry partners**



# What has the Partnership learned?

- Corn grain yields ranged from 5.0 to 14.3 Mg ha<sup>-1</sup> (80 to 227 bu/acre)
- Average grain yield response to stover harvest was minimal:
  - 9.8, 10.1, and 10.1 Mg ha<sup>-1</sup> (156, 160, and 160 bu/acre) for:
    - No, moderate (3.9 Mg ha<sup>-1</sup> or 1.7 tons/acre), or high removal (7.2 Mg ha<sup>-1</sup> or 3.2 tons/acre)
- Sustainable stover harvest rates are site specific – averages are meaningless
- Diversifying the Midwest landscape can increase sustainable quantities of harvestable stover

# BUT– Excessive Stover Harvest Can:

Degrade structure & aggregation causing –

Compaction & crusting

Water & wind erosion

Reduced plant growth

Impaired soil biology

Decreased yield

Reduced Soil Productivity



# Other Lessons

- Compared to harvesting only grain – N, P, and K removal are increased by at least 16, 2, and 18 kg Mg<sup>-1</sup> of stover
- Minimum residue return projections for 35 studies were  $6.38 \pm 2.19$  Mg stover ha<sup>-1</sup> yr<sup>-1</sup>
- For grain yields  $\leq 11$  Mg ha<sup>-1</sup> (175 bu ac<sup>-1</sup>), ten years of stover harvest, even with no-tillage, resulted in reduced POM (particulate organic matter) accumulation
- Low corn yields shifted the dry aggregate distribution toward smaller soil aggregates
- Insufficient yields resulted in undesirable shifts in the microbial community
- Overall, sustainable supplies of corn stover may be lower than initially projected because of weather-induced yield variability



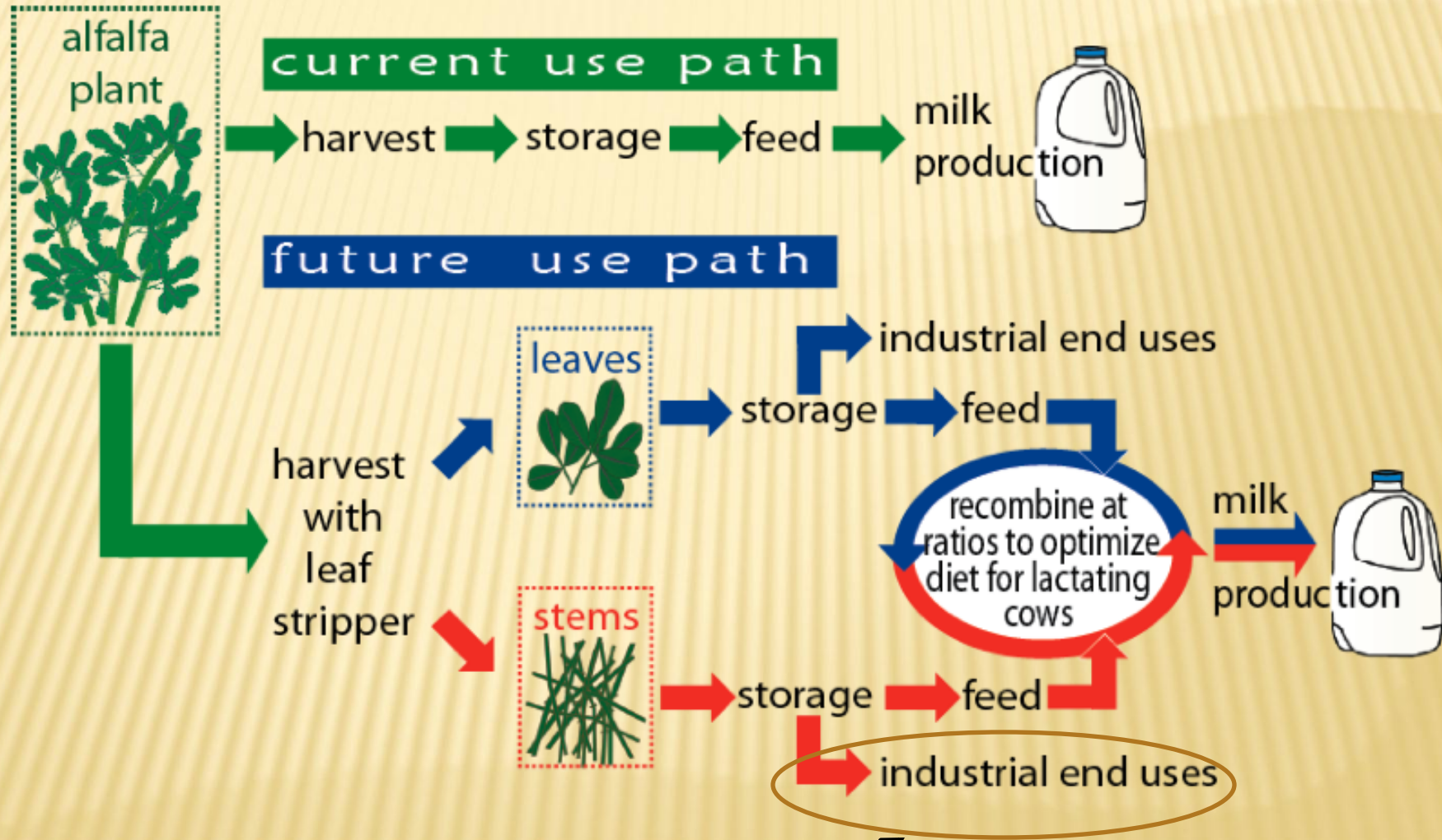
# Strategies for Landscape Diversification

- Living mulches
- Oilseeds
- Double or relay cropping
- Cover Crops





# Another strategy – an alfalfa paradigm shift



REAP goal – diversify landscape, provide feedstock, improve soil health, & protect water quality



# Alfalfa Leaf Protein Collection & Extraction



Create market-pull for perennials by starting with a familiar crop



## U.W. Platteville Pioneer Farm

Soil profile &  
water quality  
data is being  
collected in 2  
watersheds to  
establish a  
baseline as  
we scale up  
for future full-  
scale studies





# Research Needs for Landscape Diversification

- Effective and efficient strategies for including cover crops in stover harvest systems
- Low-disturbance equipment for incorporating animal manures to improve soil health and increase harvestable stover supplies
- No-tillage technologies that incorporate site-specific, on-the-go seeding and seedbed adjustments to help encourage adoption of those practices
- Innovative harvest methods and new uses for perennial crops to diversify crop rotations for improved soil health, increased yield, and sustainable stover supplies

# Summary & Conclusions

- REAP/Regional Partnership recommendations
  - Develop sub-field stover harvest practices
  - Decrease tillage intensities
  - Utilize cover crops
  - Diversify the landscape with perennials, cover crops, oilseed crops, or where feasible by double-cropping
  - Continue research and development of the Landscape Environmental Assessment Framework (LEAF) which Dave Muth will discuss in greater detail in the next presentation



# Developing Sustainable Stover Harvest Strategies was the First Step Toward Solving Landscape Energy and Ecosystem Challenges



**Any Questions?**