FFACCTs: December 5, 2014

GOT TREES?

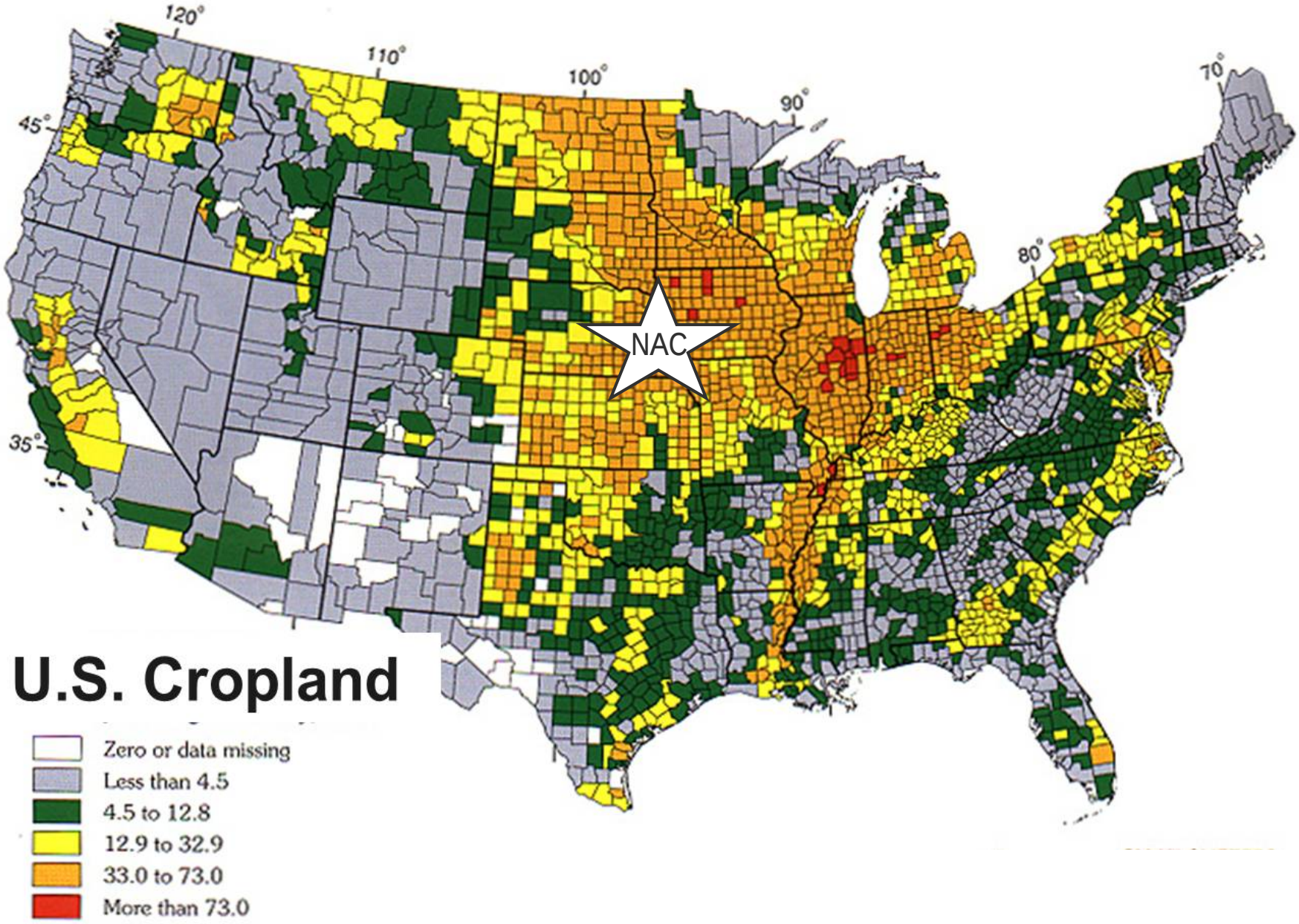
Building Climate-Ready Agriculture

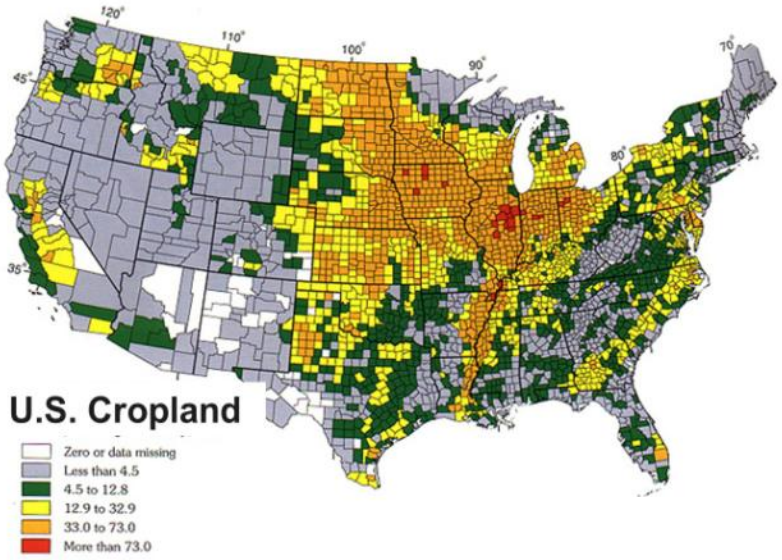
Michele Schoeneberger- Research Program Lead & Soil Scientist
U.S. Forest Service, Research & Development
USDA FS/NRCS National Agroforestry Center, Lincoln, NE

USDA National Agroforestry Center (NAC)

- Authorized in the 1990 Farm Bill, initiated 1992, & located in Lincoln, Nebraska
- A partnership between: **Forest Service R&D** and **S&PF**, and **NRCS**
- NAC works to increase agroforestry science, assistance and application by working through and relying on a ***national network of partners*****.**
- NAC's customers are the ***resource professionals*** who work with farmers, ranchers, woodland owners, Tribes and communities.

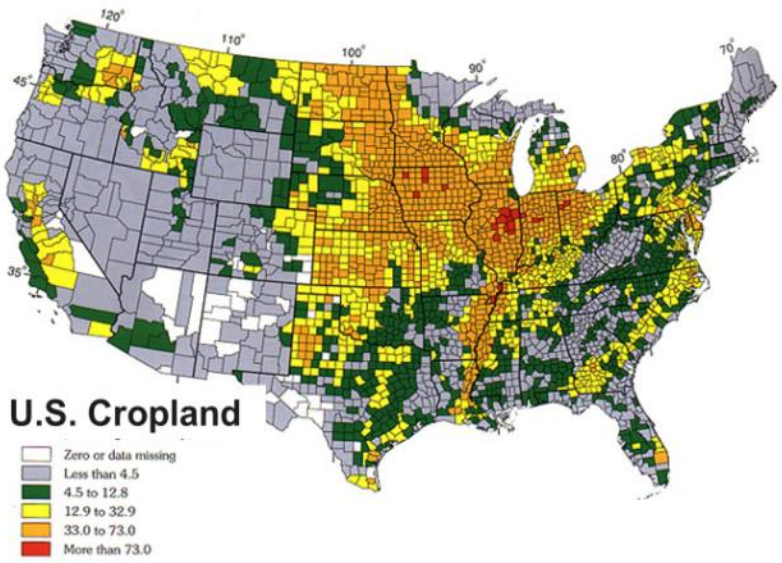
www.nac.unl.edu


120°
110°
100°
90°
70°
45°
80°
35°
NAC
U.S. Cropland
Zero or data missing
Less than 4.5
4.5 to 12.8
12.9 to 32.9
33.0 to 73.0
More than 73.0



From agricultural lands:

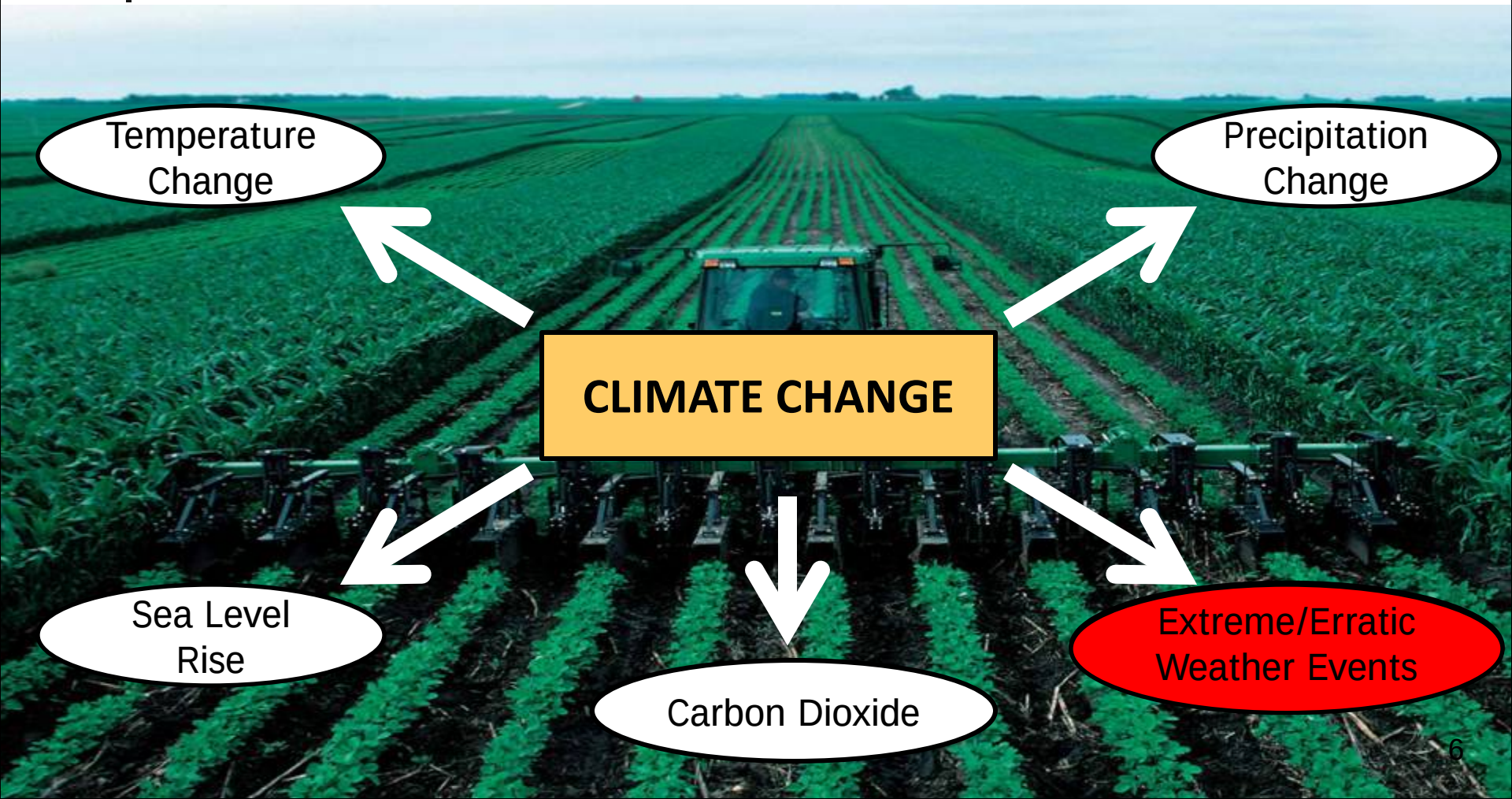
<u>We want it all.</u>



To provide for a growing population:

<u>We will need more of it all.</u>

Achieving Agricultural Objectives under Changing Climate?

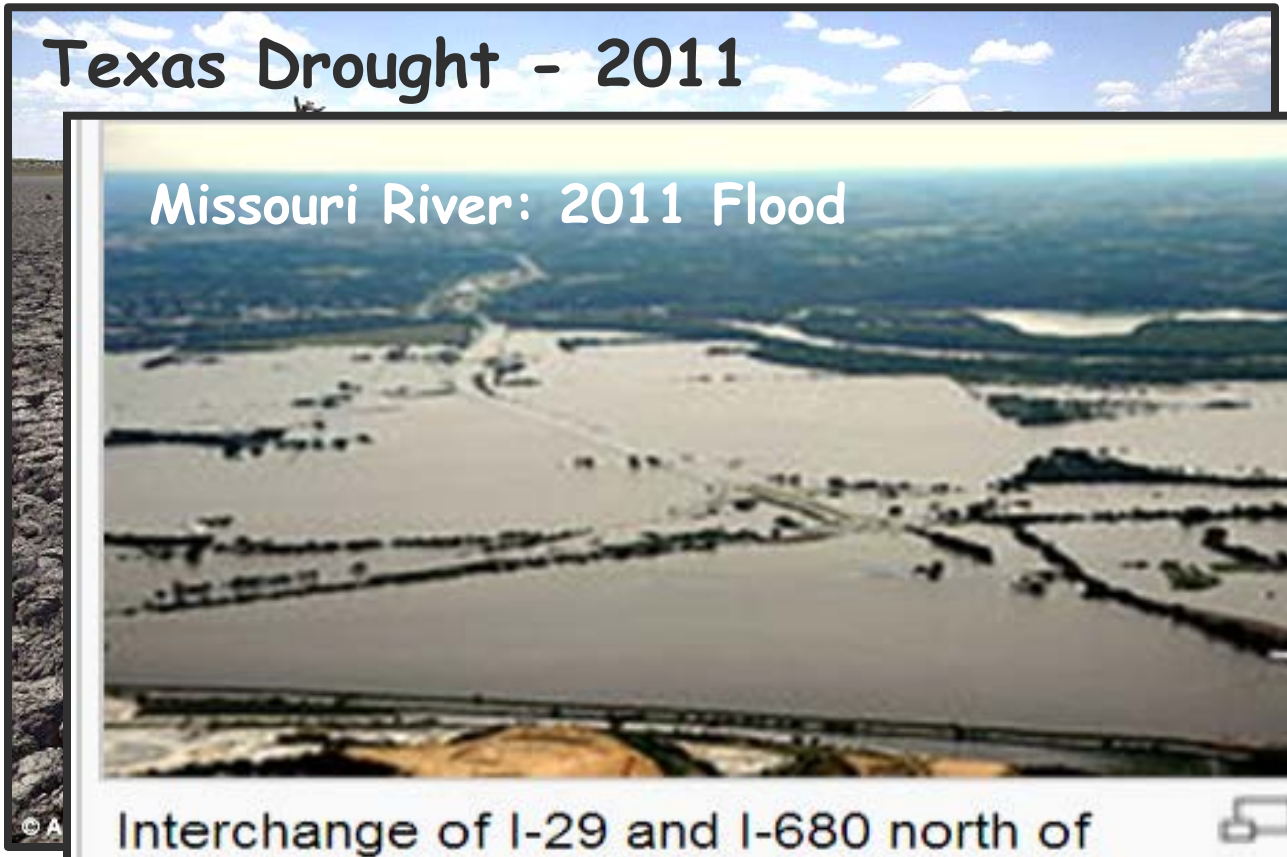


2014 US National Climate Assessment: Agriculture

→Climate disruptions to agricultural production have increased in the recent past and are projected to increase further over the next 25 years - -

with increasingly negative impacts on most crops and livestock.

- **Current erratic & extreme weather events**



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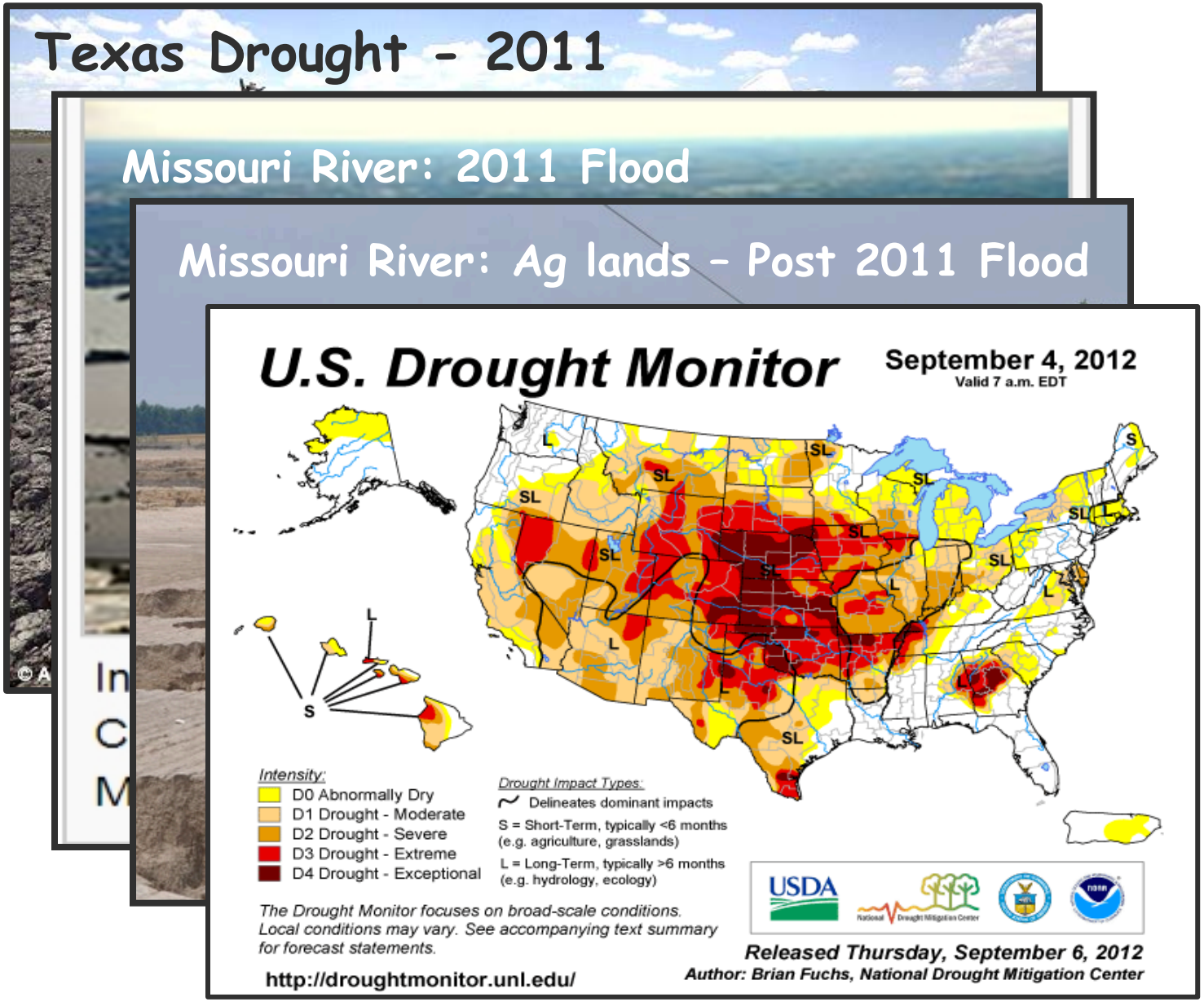

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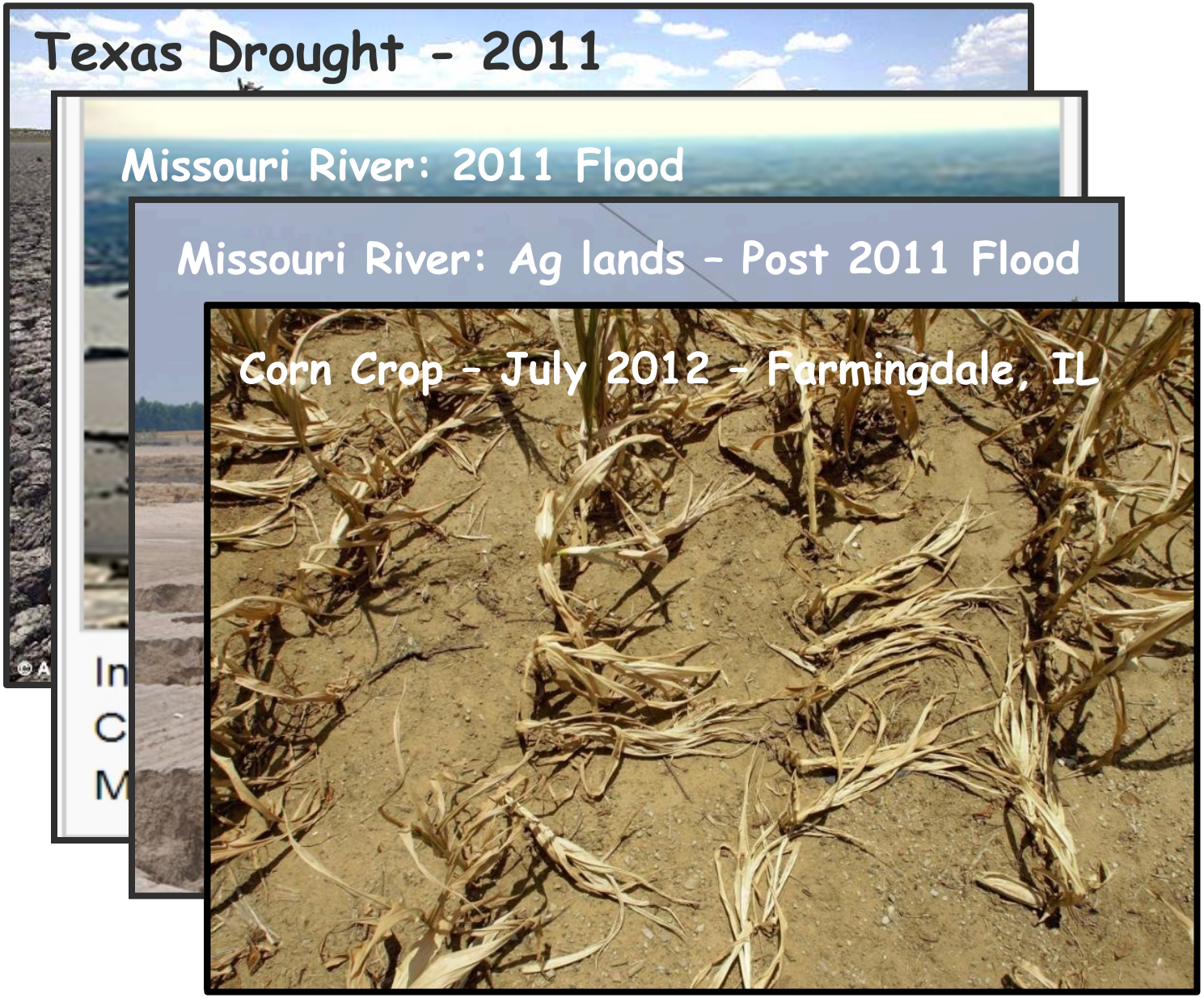


- **Current erratic & extreme weather events**

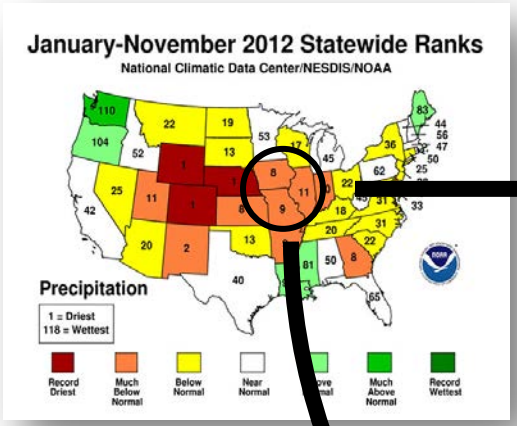
Playing with Loaded Dice

Where the probability of rolling an erratic/extreme event is now more likely.

by Gary Bentrup, USFS

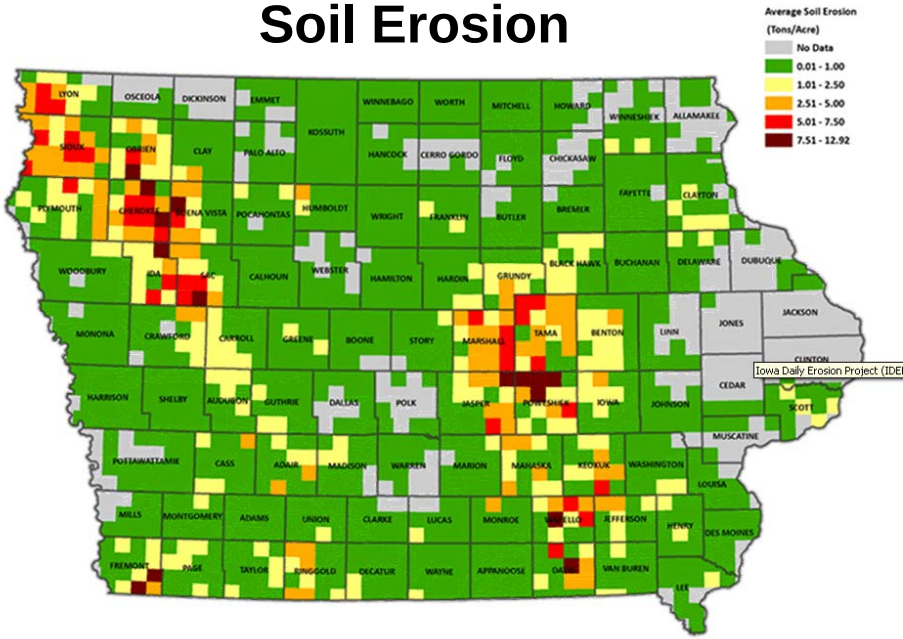
Rolling a Bad Combination

2012 – Worst Drought Since 1936



2013 Wettest Spring On Record In Iowa

May 25-29, 2013
Soil Erosion

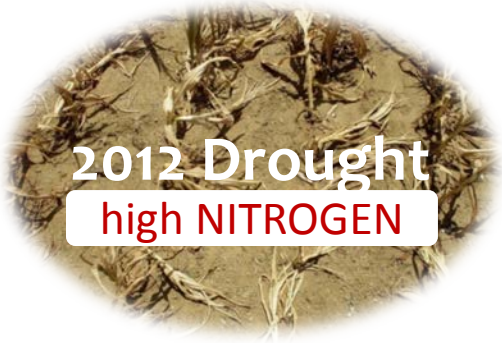


IMPACTS:

→ Current productivity

→ Longer-term productivity

- ❑ Avg. field erosion of **more than 5 tons/ac**
- ❑ In 15 of those townships, avg. erosion of **7.5-to-13 tons/ac**



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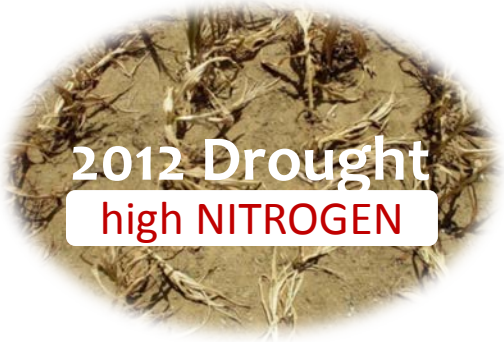

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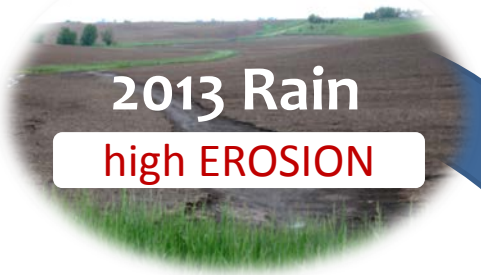


IMPACTS

→Current productivity

→Longer-term productivity

2012-2013 BAD COMBINATION

LOCAL to REGIONAL level degradation of water quality

(i.e.,Gulf Hypoxic Zone)

When climate is kicking our butts…

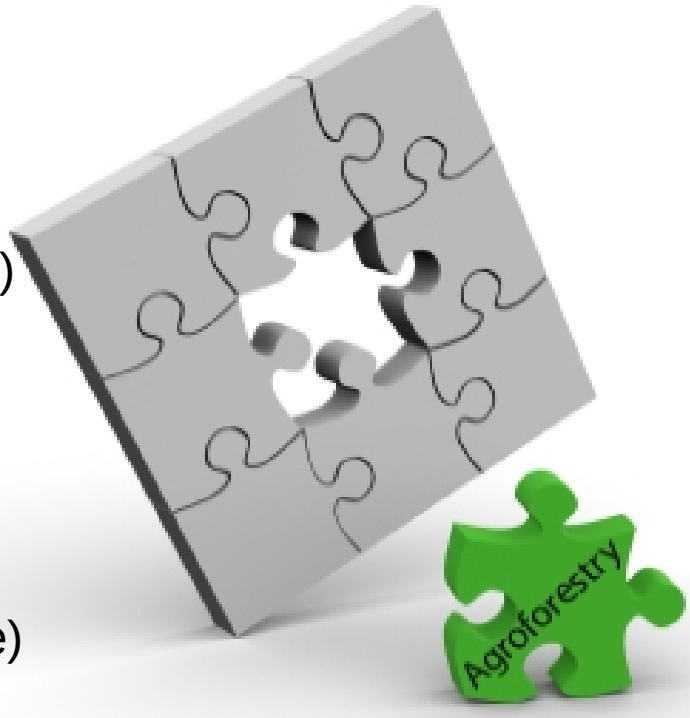
We need to be able to hedge our bets to reduce risk!

Climate-Ready Toolbox for Ag

by Gary Bentrup, USFS

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 is

Agroforestry isn't…

Agroforestry isn't…

……AFFORESTATION

It doesn't replace agriculture ~ Rather it is a management activity to help ***support*** agriculture.

Agroforestry is…

The ***intentional*** mixing of agricultural and forestry elements to help build productive, healthy & resilient operations and landscapes.

Agroforestry: Working Trees Building Climate-Ready Agriculture

….the right trees in the right places for the right jobs.

Agroforestry: one strategy that supplies multiple services

- Diversity of income
- Crop protection & enhancement
- Livestock protection
- Protection of soil resources
- Water & air quality
- Biofeedstock
- Wildlife habitat
- Biological pest control
- Pollinator services
- Recreational opportunities
- Aesthetics
- Storm water mngt.

……..*and more.*

….*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

Agroforestry: A 'Leatherman' w/in the 'CC-Integrated' Toolbox for Agriculture

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Agroforestry: Reducing Threats & Enhancing Resiliency in Ag-Lands

Risk management difficult in monocultures and annual-only systems.

Mixing in woody plants offers:

- Crop diversification
- Structural and functional diversity

Microclimate modification: crops

- 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)***

Microclimate modification: forage

- 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 CO_2 reduce forage quality. Shading may increase forage quality (increasing protein content while reducing fiber). ***(Morgan et al. 2004; Kallenbach et al. 2006)***

Microclimate modification: livestock

- 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. ***(Mitlöhner et al. 2001)***

Microclimate Benefits - Livestock

- Improved feed intake
- Improved weight gain
- Improved milk production
- Improved animal condition
- Improved breeding efficiency

(Walters 2011)

Silvopastures could be key to help mitigate *'thermal environmental challenges'* presented under climate change.

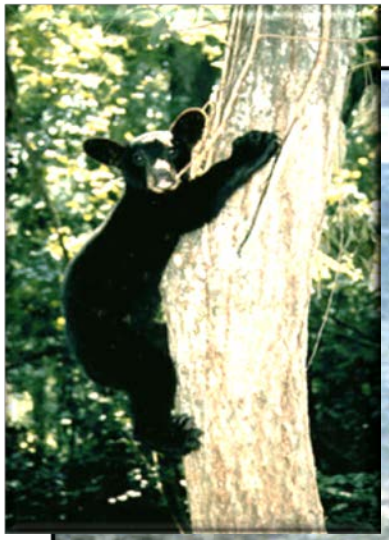
Habitat diversification

- Agroforestry plantings provide critical habitat to honeybees and other native pollinators
- Natural enemies to crop pests.

Habitat diversification: Connectivity

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

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*

Maintenance and Protection: soil

- Protecting soil resources by reducing wind velocity. ***(Tibke 1988)***

- 2° C increase in annual temp. (CC-predicted level) could increase wind erosion by 15-18%. ***(Lee et al. 1996)***


Kansas, April 2014
August 13, 2014
40-50 mph winds
Eastern Washington


Road fatality/Vehicle pile-up: Nebraska City, NE 4/02
Road pile-up/Injuries: Grand Junction, CO ~ 4/02
20 vehicle pile-up/Injuries: Burley, ID ~ 5/6/02
2 deaths/9 Injuries: Beaver Crossing, NE ~ 5/22/02
3 deaths/Vehicle pile-up: Big Springs, NE ~ 8/22/02
idaho news
Dust Storm ~ 2002

Maintenance and Protection: water

- Protecting water quality through interception of 'excess' N and other nutrients, sediments, agrichemicals.

- Ratio of erosion increase to annual rainfall increase is on the order of 1.7. (*Nearing et al. 2004*)

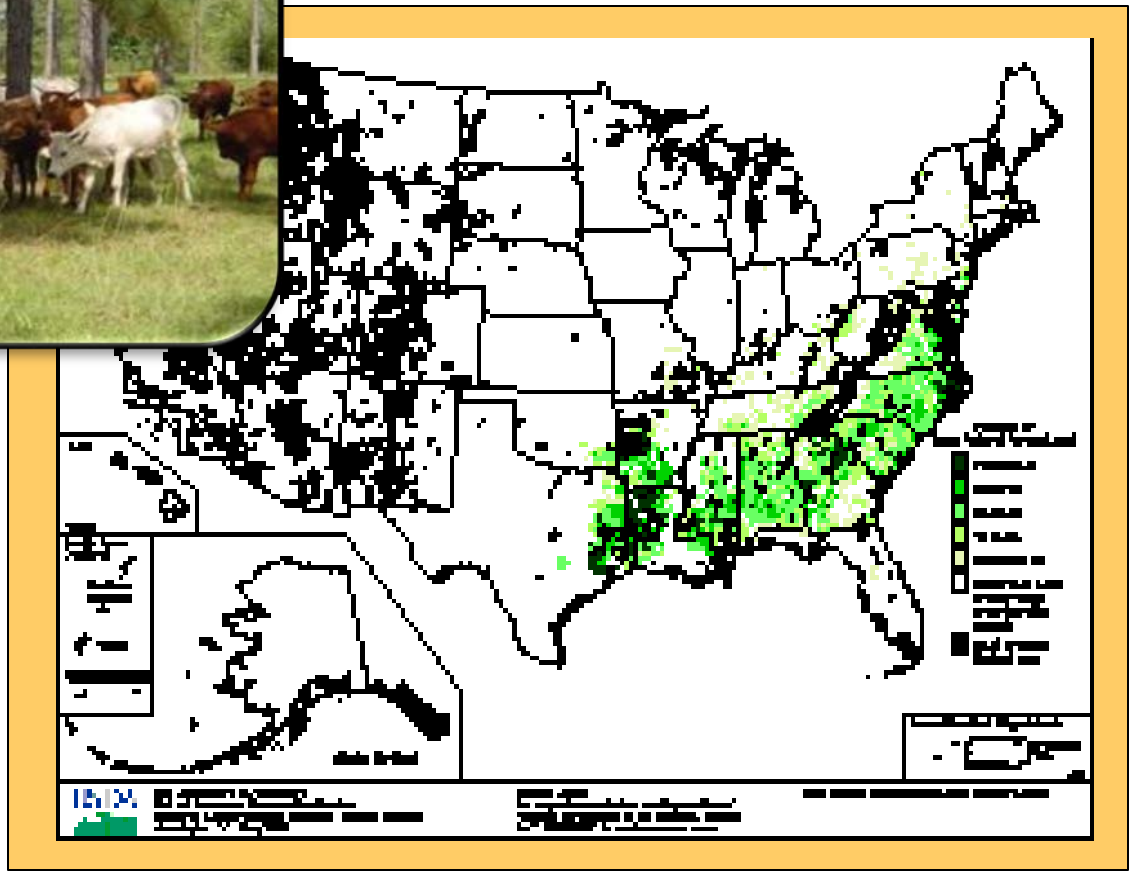
Diversified production opportunities

Alley Cropping

Silvopasture

Reducing risk & building resiliency by providing both annual and longer-term (high-value) income opportunities.

High Potential for Silvopasture in southeastern USA



Alley Cropping/Silvopasture Systems

- Not prime ‘Corn/Soybean’ land
- Already experiencing erratic & extreme events

CEFS
CENTER for ENVIRONMENTAL FARMING SYSTEMS

Agroforestry: alley cropping/silvopasture

Advantages

- Diversification of products and economic returns
- Lower risk than monoculture crops on marginal cropland – when susceptible to floods, drought, fire, pests, diseases
- Workable alleys for short-term cropping gains and/or maneuvering of forestry harvest equipment
- Shade for livestock
- Enhanced wildlife habitat – linkages to natural areas

Alan Franzluebbers, USDA ARS

USDA United States Department of Agriculture
Agricultural Research Service

Alleycropping/Silvopasture Study - NC

Alan Franzluebbers (ARS)
Fred Cubbage, Paul Mueller, Jean-Marie Luginbuhl, Wei-Shi (NCSU)
Joshua Idassi (NC A&T)

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

NC STATE UNIVERSITY

Department of Soil Science
College of Agriculture and Life Sciences

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DEPARTMENT OF
FORESTRY AND ENVIRONMENTAL RESOURCES

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Objectives

1) NC agroforestry demonstration for landowners, farmers, and professionals
2) Long-term research of alley cropping and transition to silvopasture
3) Measure production tradeoffs of trees and crops / silvopasture
4) Research site for graduate students and professors with interests in agroforestry systems

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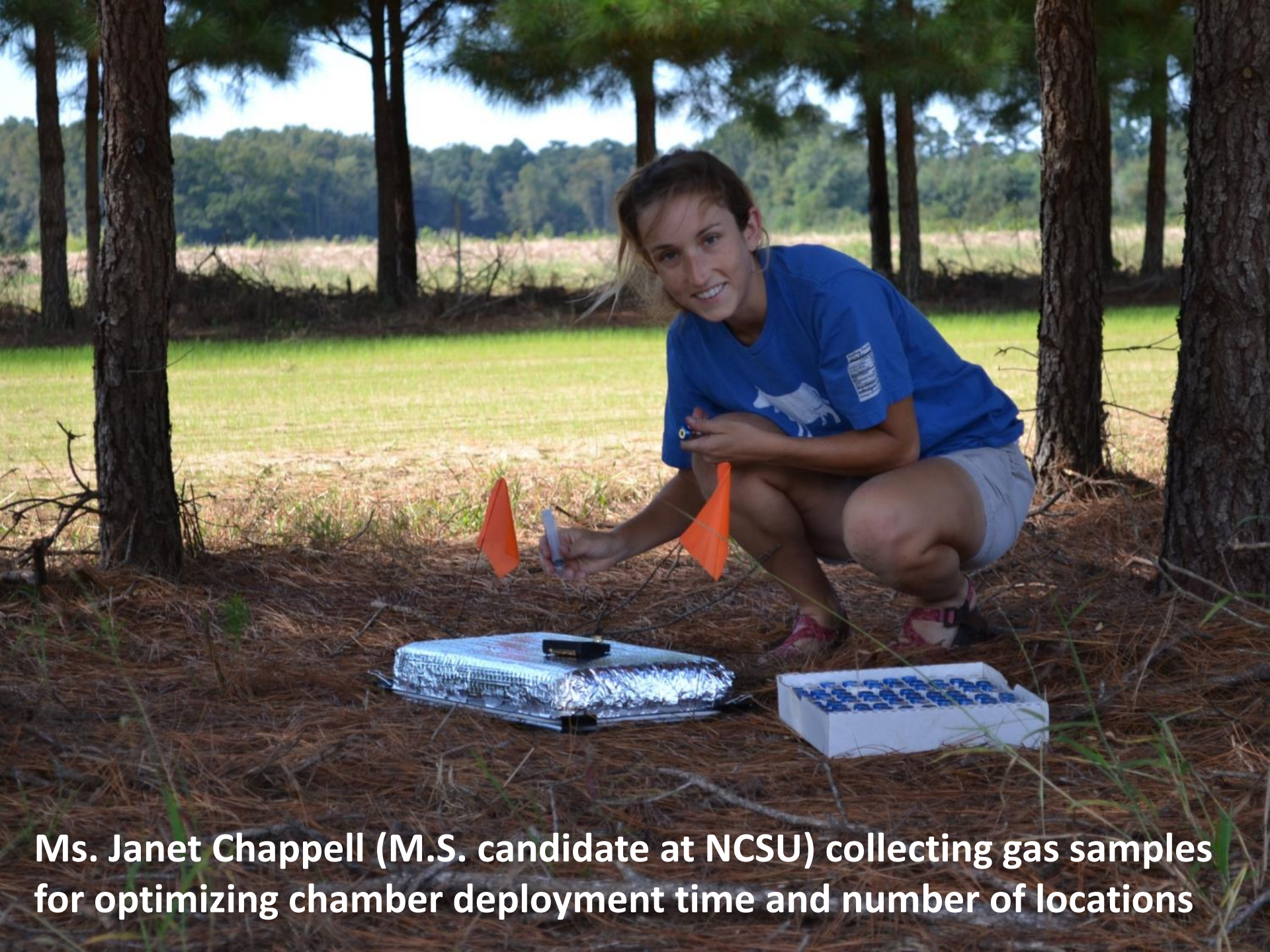


Ms. Janet Chappell (M.S. candidate at NCSU) collecting gas samples for optimizing chamber deployment time and number of locations

Agroforestry as a 'Climate Change Integrated' Conservation Option for Temperate Ag Lands

Guidelines & Tools

Science Synthesis

Communication

- Internally
- Externally

Meeting the 'NOW'

Agroforestry & Climate Change:

Reducing Threats and Enhancing Resiliency in Agricultural Landscapes (May 2014, Nebraska City, NE)

- **Purpose**: to produce a USDA technical report on the potential of agroforestry to serve as a mngt option for both GHG mitigation & climate change adaptation.

Anticipated release date ~ May 2015

Targeting:

AgBufferBuilder: *to enhance WQ protection using the least land*

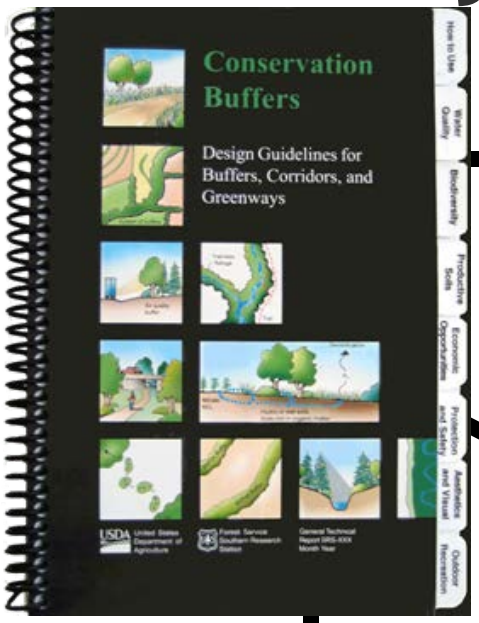
Better matching land use & mngt to land capability & needs

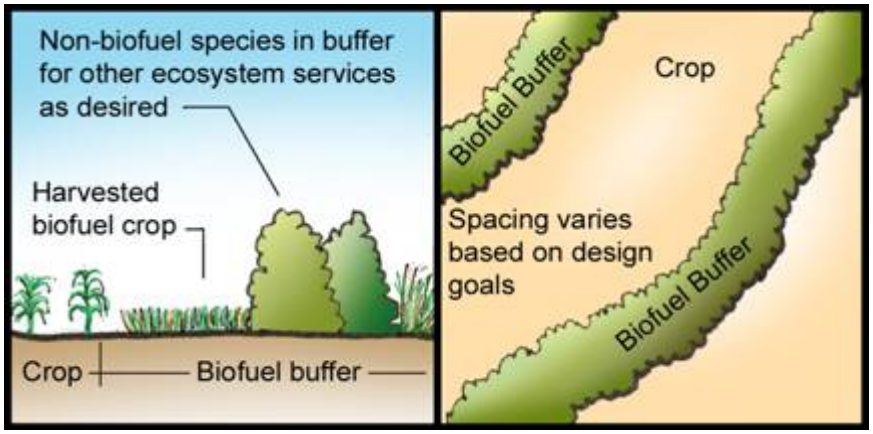
Field	147 ac
Buffer	10 ac
Constant	35 %

Field	147 ac
Filter	10 ac
Target	72 %

Mike Dosskey, mdosskey@fs.fed.us

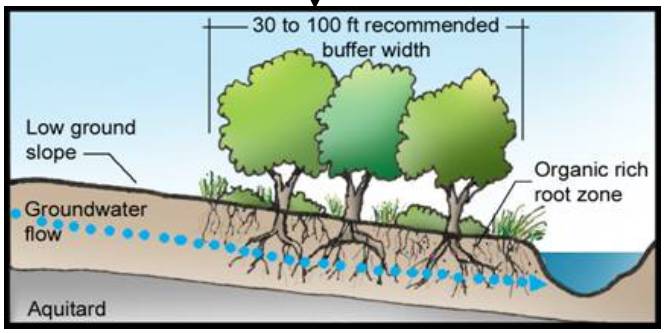
Diversity & Multifunctionality



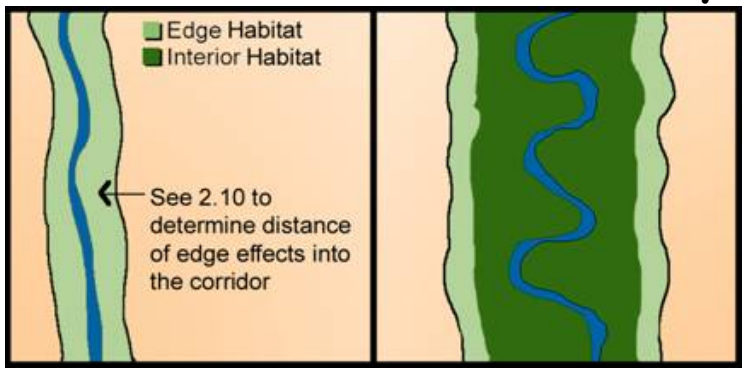


Biofuels

Water quality

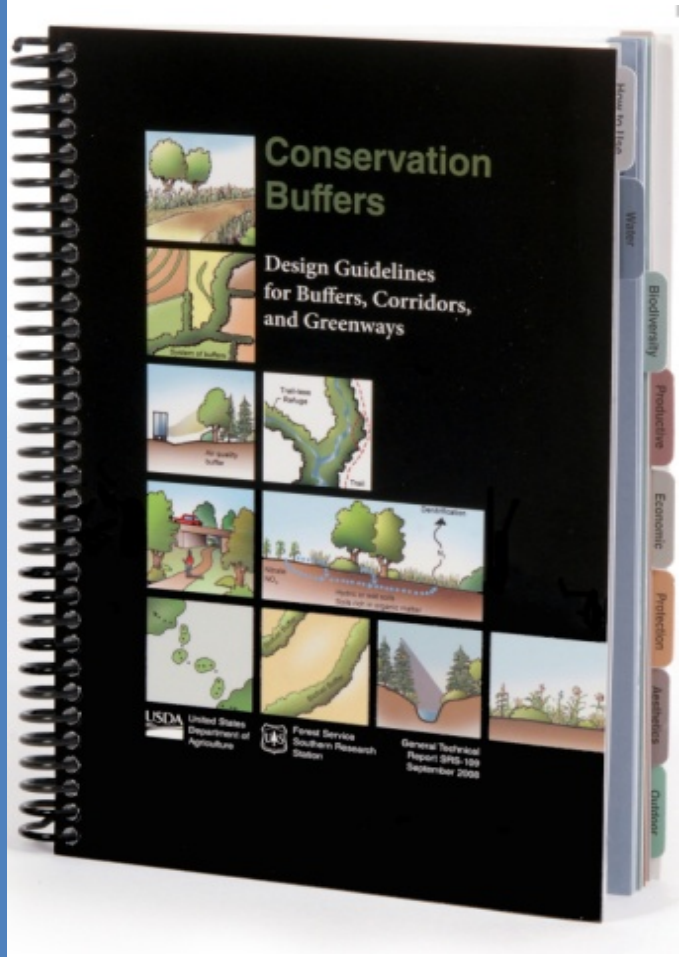


Biodiversity



Gary Bentrup, gbentrup@fs.fed.us

Diversity & Multifunctionality



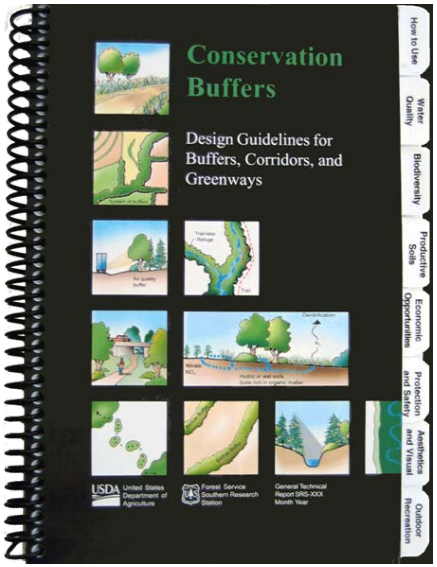
- To facilitate multifunctional/multi-use planning & design.
- To facilitate the consideration of landowner &/or community issues in the buffer planning process.

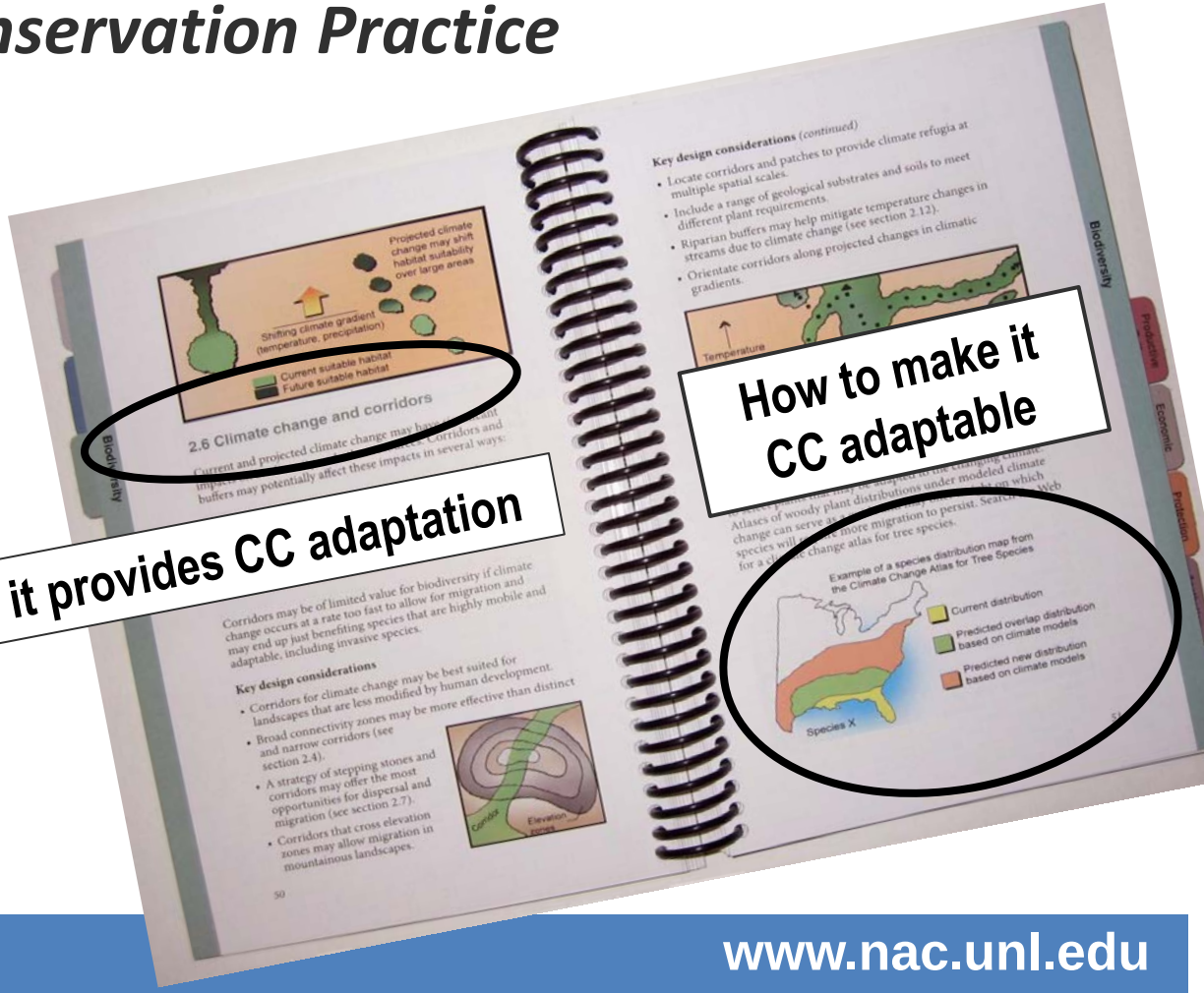
Gary Bentrup, gbentrup@fs.fed.us

Climate change:

- **Evidenced-Based Guidelines:**

CC-Integrated Conservation Practice





A new *Private Lands* paradigm

Bringing *landowner, community & industry* together to create a shared/diversified vision

Visual Simulations

CanVis

Gary Bentrup, gbentrup@fs.fed.us

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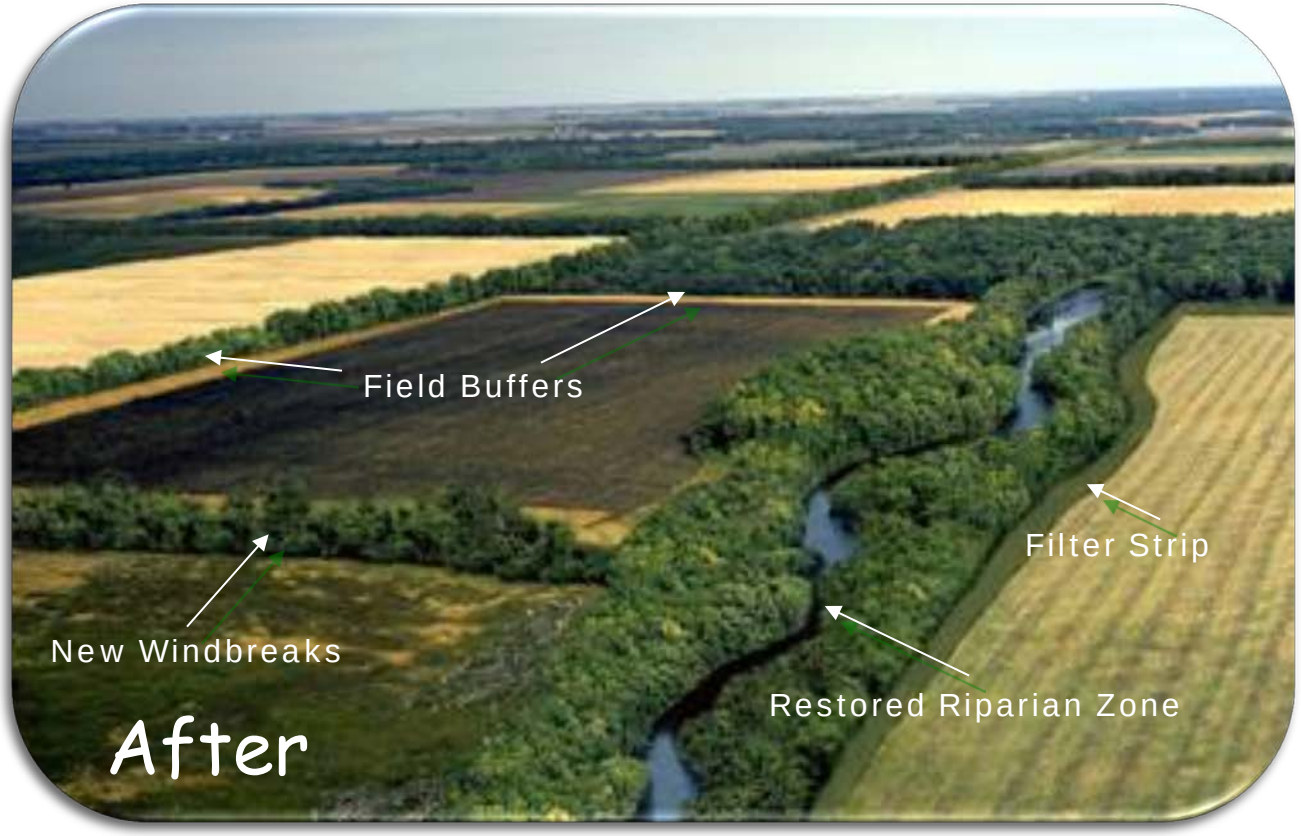

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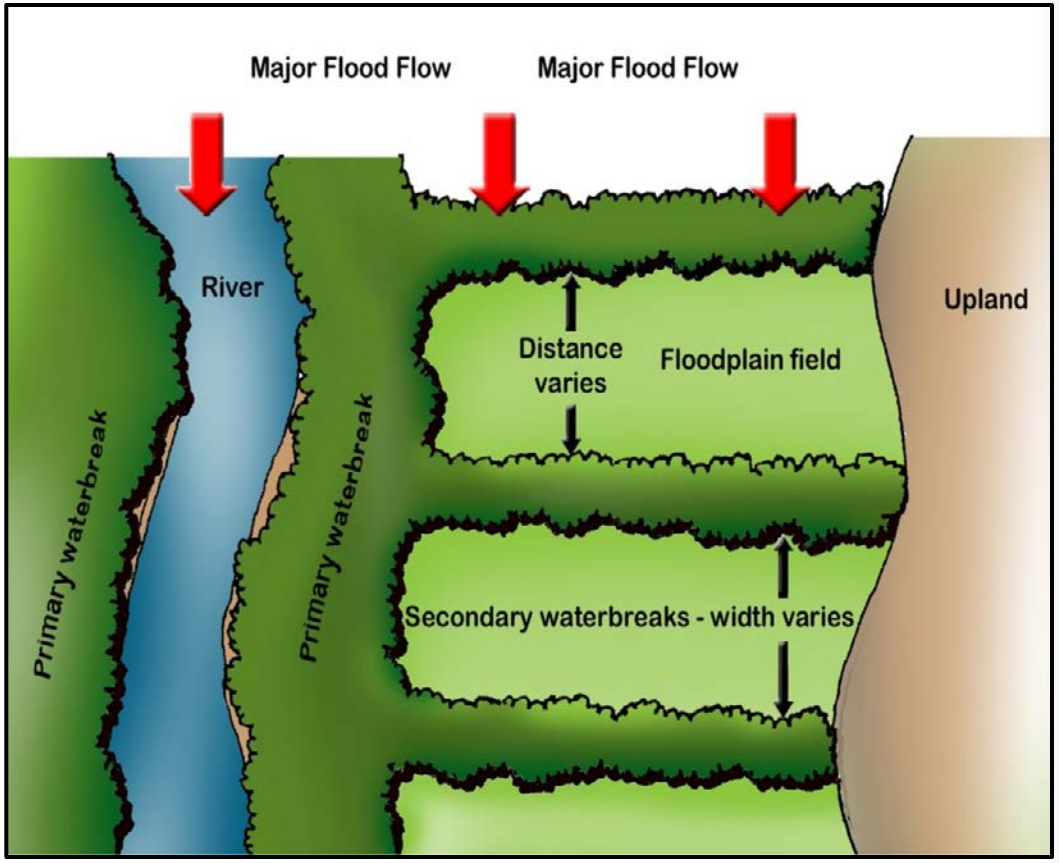
Rethinking the Tools for Building *Climate-Ready* Agriculture

- *Frequency* and *levels* of flooding are predicted to increase under projected climate senarios.
- Loss of crops and degradation of land; affecting subsequent production
- While we may not be able to control the first; we need to find ways to minimize the second.

Interchange of I-29 and I-680 north of Council Bluffs, Iowa looking towards the Mormon Bridge on June 16

Rethinking the Tools:
Waterbreaks



Flooding Services
- Protect levees from breaching
- Increase bank stability
- Increase sediment deposition
- Reduce gully creation
- Trap debris

Nonflood Services
- Increase wildlife habitat (food, shelter, travel)
- Enhance water quality
- Protect soil quality
- Provide alternative income (products & hunting leases)

Climate Change Services
- Protect ag. lands from degradation
- Reduce risk by diversification
- Sequester greenhouse gases
- Reduce greenhouse gas emissions
- Provide refugia for biodiversity

Agroforestry - Helping to Build Climate-Ready Agriculture

"The next revolution in agriculture won't be a result of any single factor but rather… ….

… … ….resilient production systems capable of coping with any number of stresses." *Hatfield & Sauer (2011)*

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