Opportunities to Improve Water Quality in the Mississippi River Basin

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Our Farms Our Future 2018

St Louis, Missouri

NORTH CENTRAL REGION WATER NETWORK

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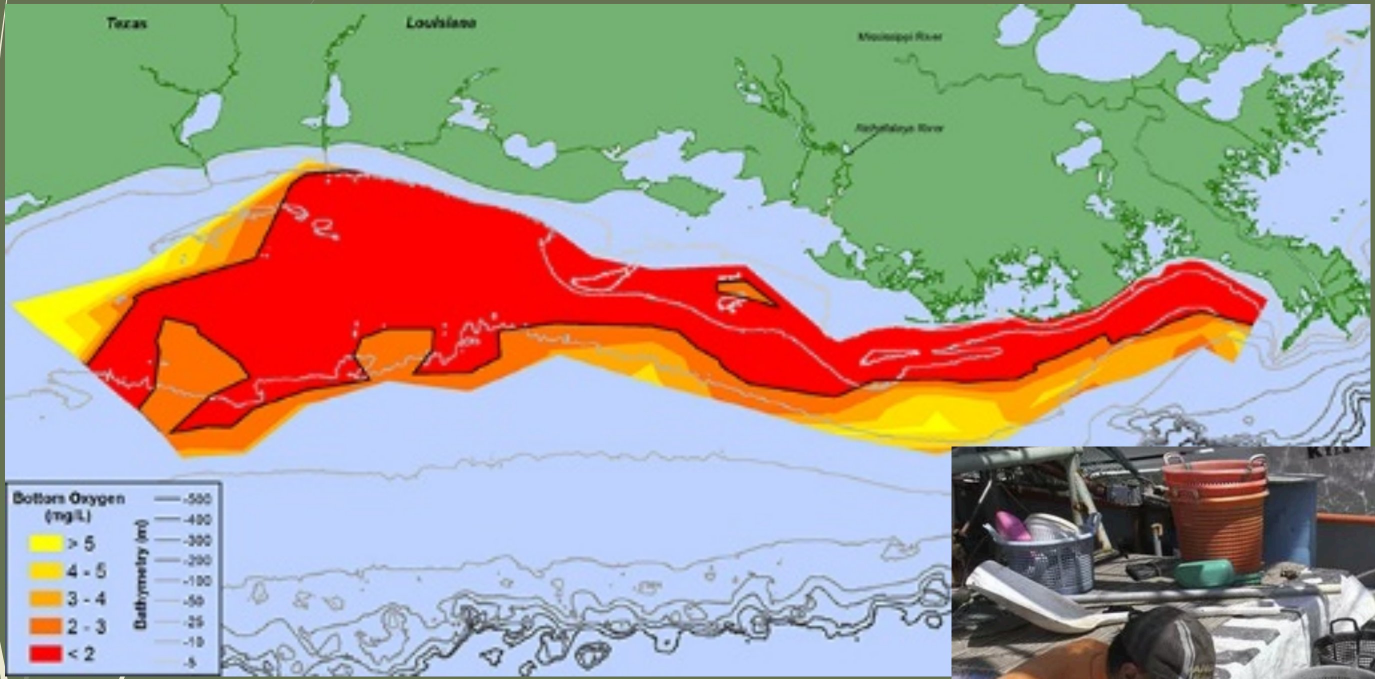
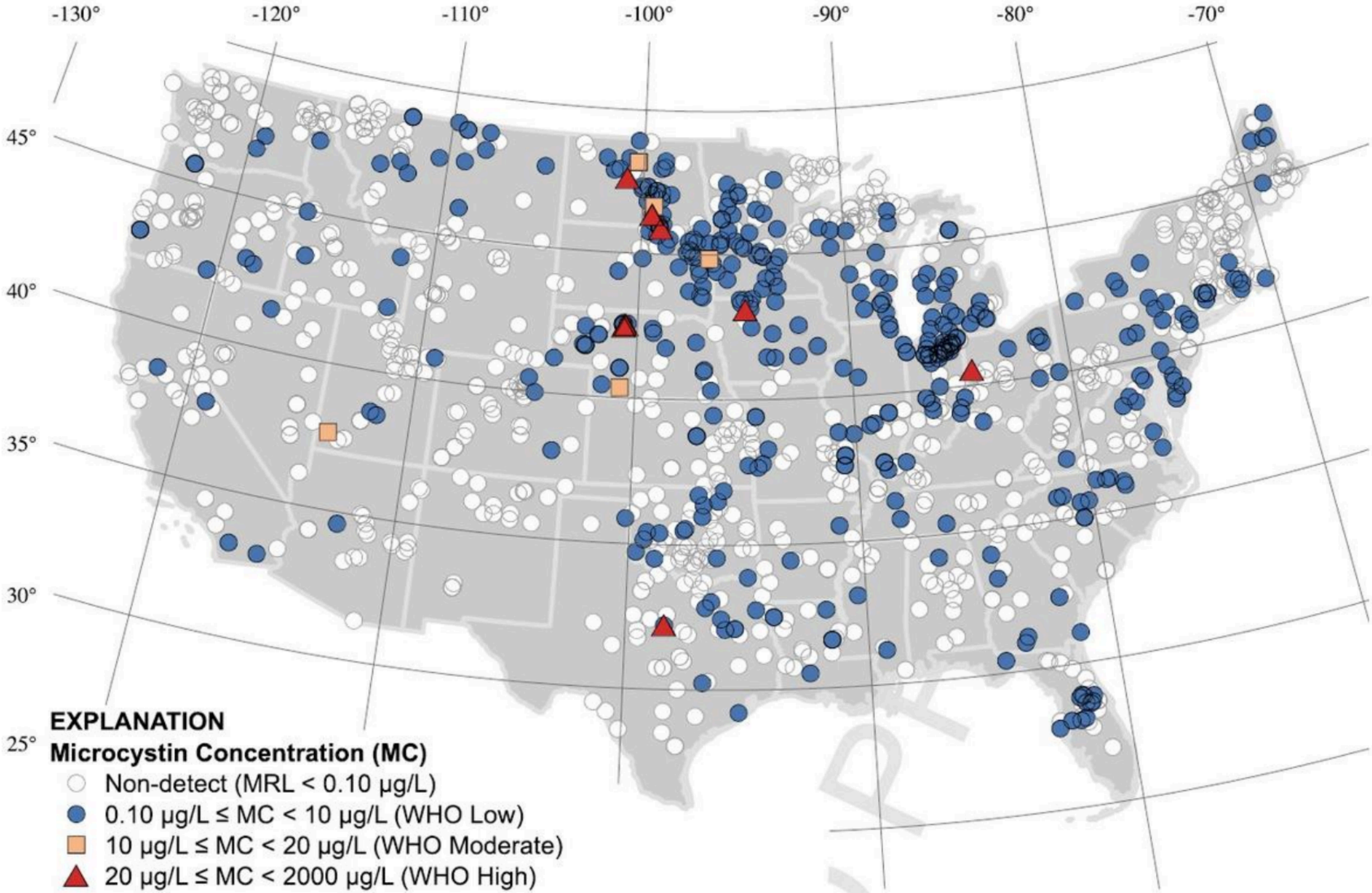
The Mississippi River Basin Challenge



From Nancy Rabalais (LSU/LUMCON)

Photo Credit: John Fitzhugh

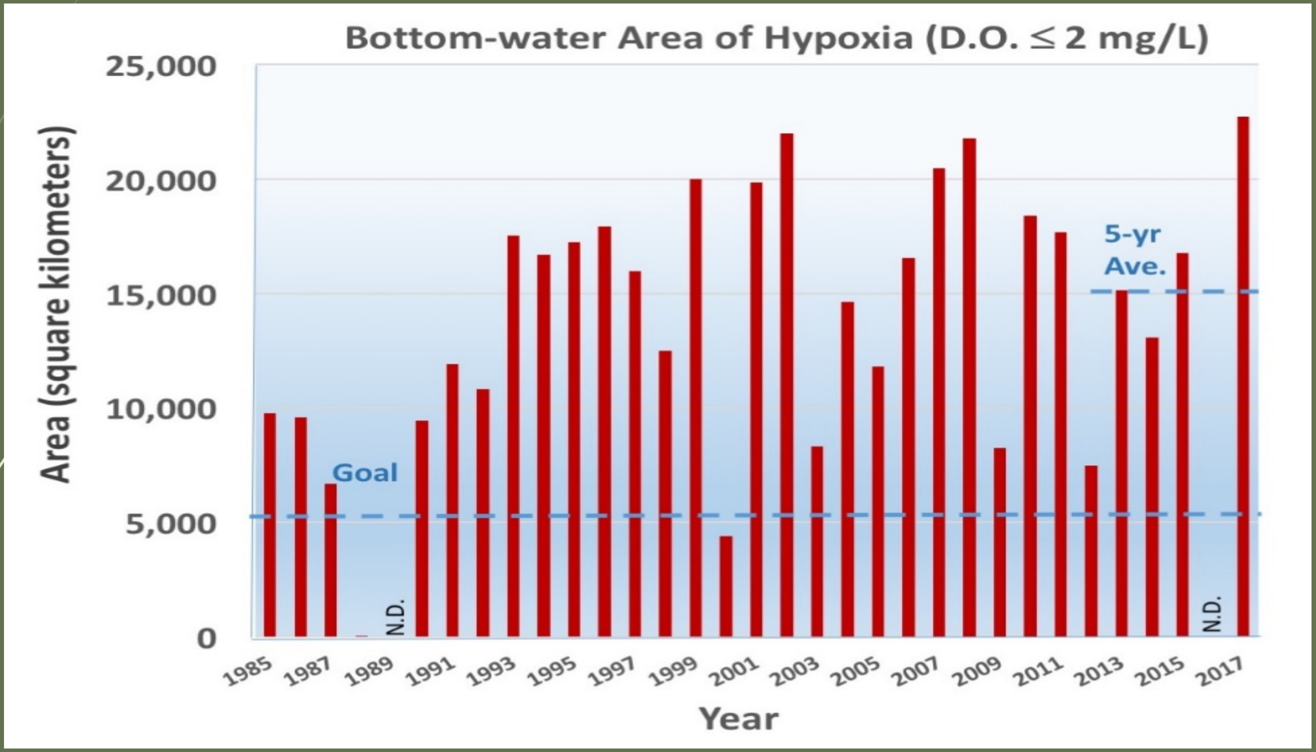
Photo Credits: Lauren Mills Shotwell, Chris Zoeller, and Erin Irish



This map shows all of the lakes tested and those in which samples contained microcystin toxins.

USGS and USEPA National Lakes Assessment 2012 - https://on.doi.gov/1WBh52z

How are we doing?



Coastal Goal

By 2035, reduce 5-year running average size of the Gulf hypoxic zone to 5,000 km^2

Interim Target

20% reduction of nitrogen and phosphorus loading by 2025

From Nancy Rabalais (LSU/LUMCON)

Opportunities to Improve Water Quality in the Mississippi River Basin

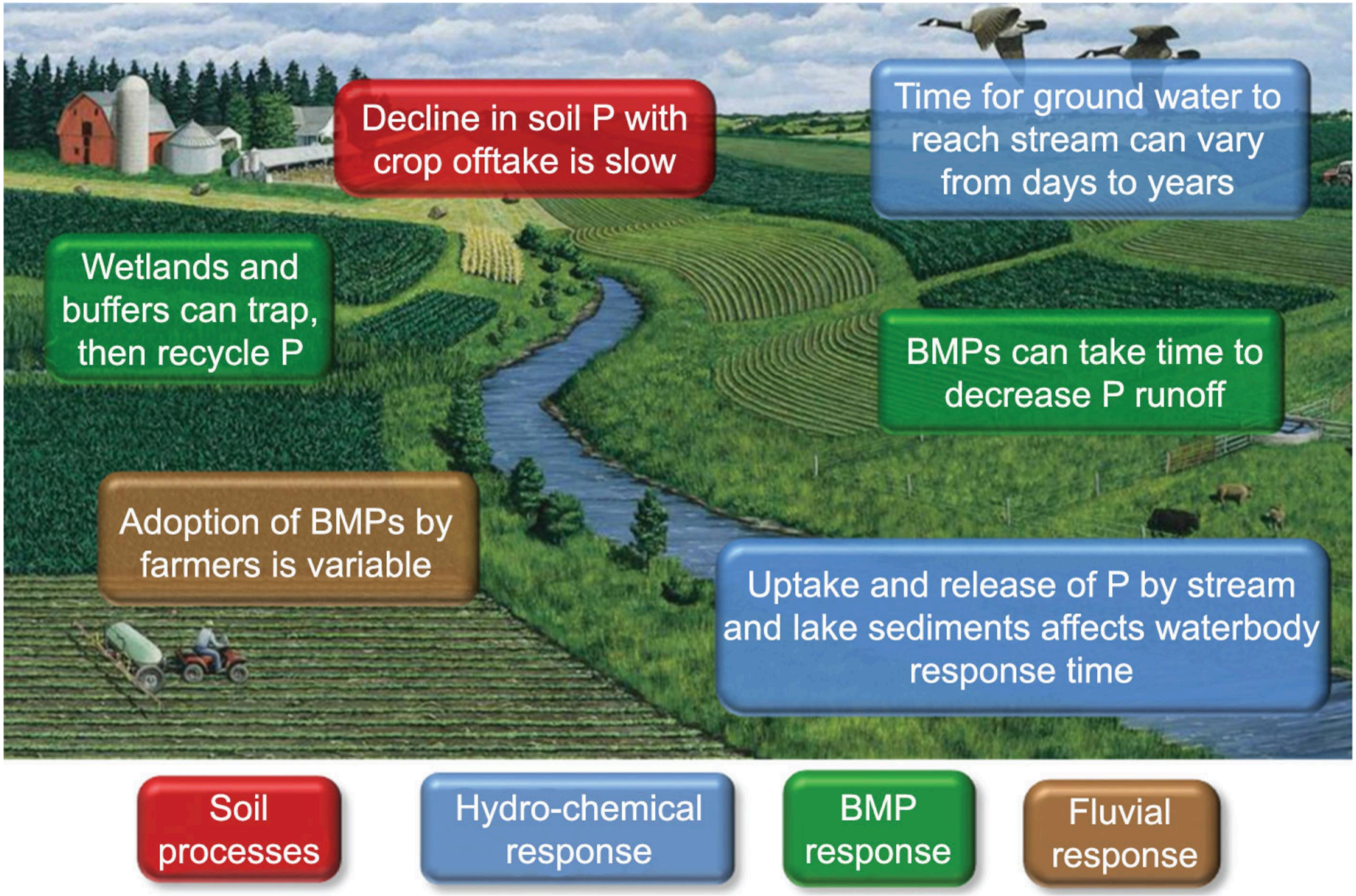
- Given current agricultural systems, nutrient management and removal practices are necessary
- Changes in agricultural systems can provide multiple benefits
- Precision agriculture can help farmers optimize land use for profitability and ecosystem services
- A unified, full scale watershed approach is necessary to achieve water quality and quantity goals
- We need farmer and ag sector leaders more than ever before

Given current agricultural systems, nutrient <u>management</u> and <u>removal</u> practices are necessary

Adapted From Table 4. Simulated Conservation Scenarios In the Upper Mississippi and Ohio River Basins from McLellan et al. 2015

Scenarios				Results					
			Catchments Used			Across UMORB			
SC	Practices Included	Practice Implementation Level[1]		Reduction in Nitrogen Load Delivered to UMORB Outlet Across UMORB		Area of Nitrogen Removal Practices		Area of Cropland Converted[4]	
			Total Number Used	Total Load (kg ³ 10⁶/yr)	% of Baseline	Total Area[3] (ha)	(%)	Total Area[5] (ha)	(%)
	Improved fertilizer management	25% of cropland in UMORB		22.0	3.2	N/A	N/A		
	Cover crops	25% of cropland in UMORB		32.0	4.3	N/A	N/A		
	Restoration of drained depressional wetlands	Up to 10% of eligible land in each catchment used		2.8	0.4	163,366	1.4		
	Creation of riparian buffers Untiled hydric cropland	100% of eligible land in each catchment used		4.9	0.7	69,624	9.6		
	Tiled hydric cropland	100% of eligible land in each catchment used		0.5	0.1	32,139	17.9		
	Creation of tile-drainage treatment wetlands	Up to 10% of eligible land in each eligible catchment used		23.3	3.4	60,352	2.0		
	Ditch-enhancement practices	100% of eligible land in each catchment used		—	—	5,987	3.0		
	Stream-channel restoration	100% of eligible land in each catchment used		47.6	6.9	69,648	18.7		
	Floodplain reconnection	100% of eligible land in each catchment used		180.4	26.0	427,082	28.6		
6RT			1,557	311.7	45.0	868,199		752,563	2.5

Managing agricultural phosphorus to minimize water quality impacts (Sharpley 2016)



The Influence of Legacy P on Lake Water Quality in a Midwestern Agricultural Watershed (Motew et al 2017)

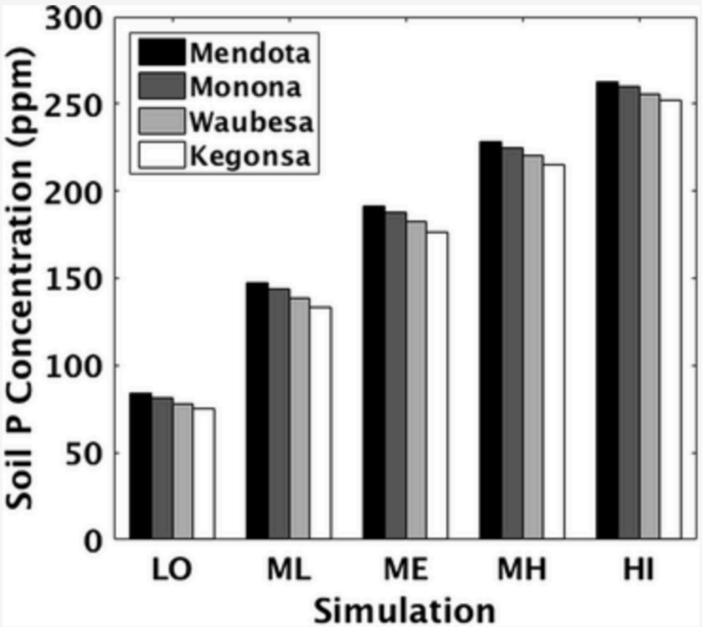


Figure 4

Surface soil P concentration in croplands (ppm) averaged over area and the 1986–2013 time period.

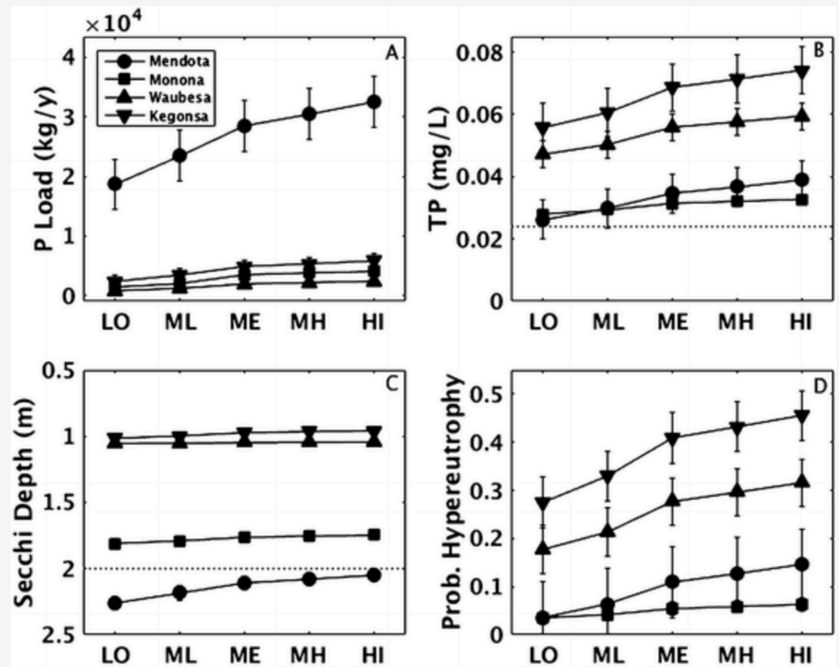


Figure 7

Water quality indicators for each simulation including **A** direct drainage P load (kg y^{-1}), **B** in-lake summer TP concentration (mg l^{-1}), **C** Secchi depth (m), and **D** probability of hypereutrophy. *Dashed lines* indicate the mesotrophic boundary.

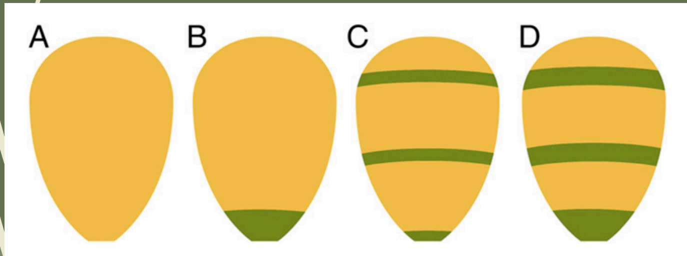
Changes in agricultural systems can provide multiple benefits

Systems and Ecological Literacy

- 4 laws of ecology (Commoner 1971)
  1. Everything is connected to everything else
  2. Everything must go somewhere
  3. Nature knows best
  4. There is no such thing as a free lunch

Perennialization, Diversification

- Adding perennials
  - Cover crops
  - Prairie strips



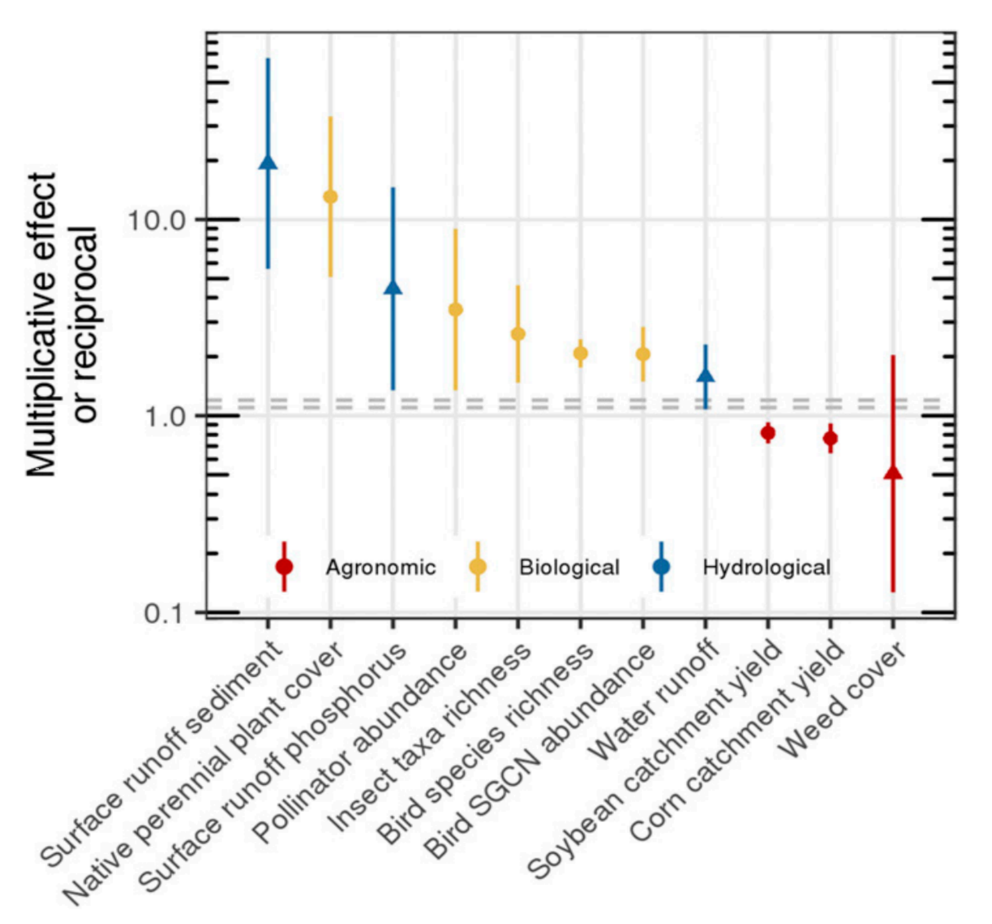


Photo Credit: Joe Link

http://www.pnas.org/content/114/42/11247

Perennialization, Diversification

- Perennial agricultural systems
  - Switchgrass and other perennial bioenergy crops
  - Kernza and other perennial food crops
  - Pasture-based meat, dairy, and animal fiber production



Photo Credits: Rob Mitchell, Patagonia Provisions, and Cheyenne Christianson

Iowa Nutrient Strategy Science Assessment Table 2 (partial). Nitrogen reduction practices – potential impact on nitrate-N reduction and corn yield based on literature review.

	Practice	Comments	% Nitrate-N Reduction+	% Corn Yield Change++
Nitrogen Management			Average (SD*)	Average (SD*)
	Timing	Moving from Fall to Spring Pre-plant Application	6 (25)	4 (16)
		Spring pre-plant/sidedress 40-60 split Compared to Fall Applied	5 (28)	10 (7)
		Sidedress - Compared to Pre-plant Application	7 (37)	0 (3)
		Sidedress – Soil Test Based Compared to Preplant	4 (20)	13 (22)
	Source	Liquid Swine Manure Compared to Spring Applied Fertilizer	4 (11)	0 (13)
		Poultry Manure Compared to Spring Applied Fertilizer	-3 (20)	-2 (14)
	Nitrogen Rate Application	Reduce to Maximum Return to Nitrogen value 149 kg N/ha (133 lb N/ac) for CS and 213 kg N/ha (190 lb N/ac) for CC	10‡	-1‡‡
	Nitrification Inhibitor	Nitrapyrin – Fall - Compared to Fall-Applied without Nitrapyrin	9 (19)	6 (22)
	Cover Crops	Rye	31 (29	) -6 (7)
		Oat	28 (2)**	-5 (1)
	Living Mulches	e.g. Kura clover - Nitrate-N reduction from one site	41 (16)	-9 (32)
Land Use	Perennial	Energy Crops Compared to Spring- Applied Fertilizer	72 (23)	-100[¥]
		Land Retirement (CRP) Compared to Spring- Applied Fertilizer	85 (9)	-100[¥]
	Extended Rotations	At least 2 years of alfalfa in a 4 or 5 year rotation	42 (12)	7 (7)
	Grazed Pastures	No pertinent information from Iowa - Assume similar to CRP	85***	NA

‘Moving the Needle in Minnesota

- 2017 University of MN Water Resources Center Report to Governor Dayton
    - Diversify Minnesota’s agricultural cropping systems so the industry thrives on a minimum of 10% of row crop acres converted to perennial crops, and incentivize this through market approaches.
    - Manage agricultural water discharges to reduce stream flow and nutrient loads.
    - Incentivize these changes through improved producer certification programs, and link them to supply chain markets to change farm practices that support clean water.

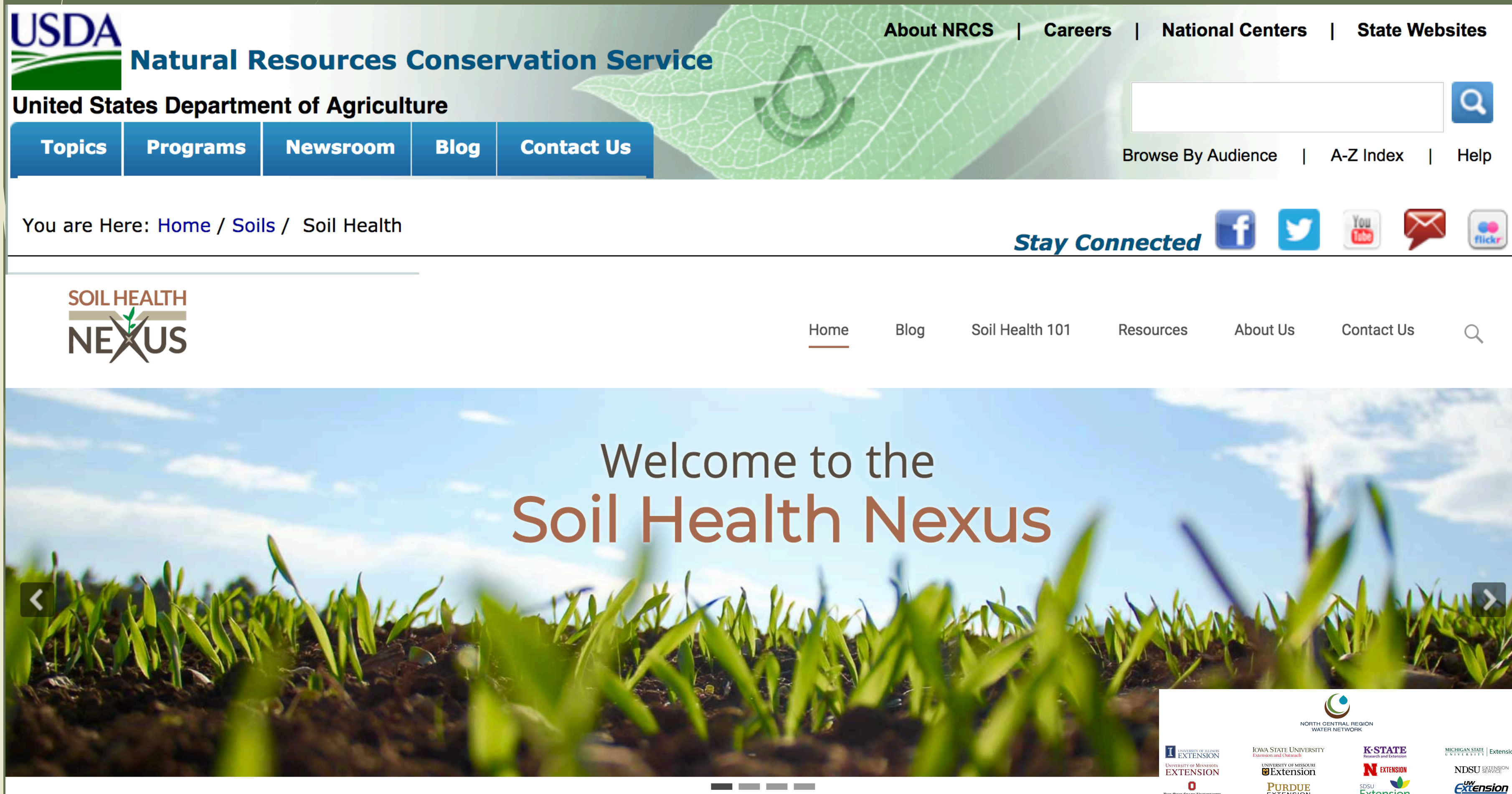
https://www.wrc.umn.edu/sites/wrc.umn.edu/files/moving_the_needle_-final_-22_may_2017.pdf

‘Moving the Needle in Minnesota

- Diversify Minnesota’s agricultural cropping systems so the industry thrives on a minimum of 10% of row crop acres converted to perennial crops, and incentivize this through market approaches.
- A.1. Goal – Transition over time the conversion of a minimum of 10% of corn/soy row crop acres to perennial plantings.
  - Develop markets to encourage adoption of alternate crops for food, fuel, fiber (i.e. go beyond ethanol).
  - Target acres with negative or low return on investment currently.
- A.2. Goal – Effect change in Federal Farm Policies

https://www.wrc.umn.edu/sites/wrc.umn.edu/files/moving_the_needle_-final_-22_may_2017.pdf

Soil Health



https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/soils/health/

http://soilhealthnexus.org/

Precision agriculture can help farmers optimize land use for profitability and ecosystem services

Precision Agriculture

- High resolution information about crop yield and profitability
- Growing ability to provide information on other ecosystem services for "non-traditional" markets including carbon and GHG impacts, wildlife habitat, nutrient management, water storage, etc.
- Field and landscape scales

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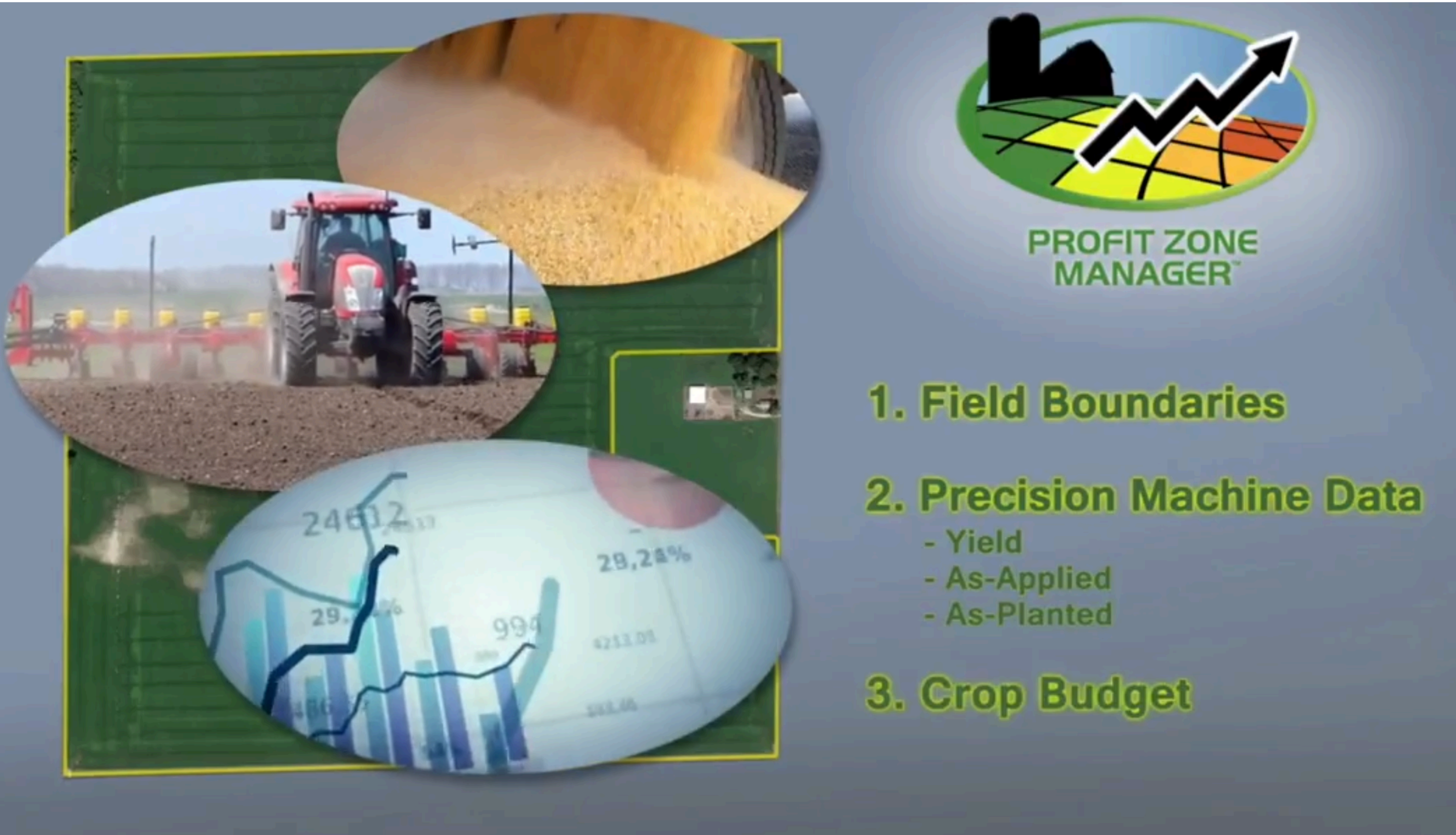
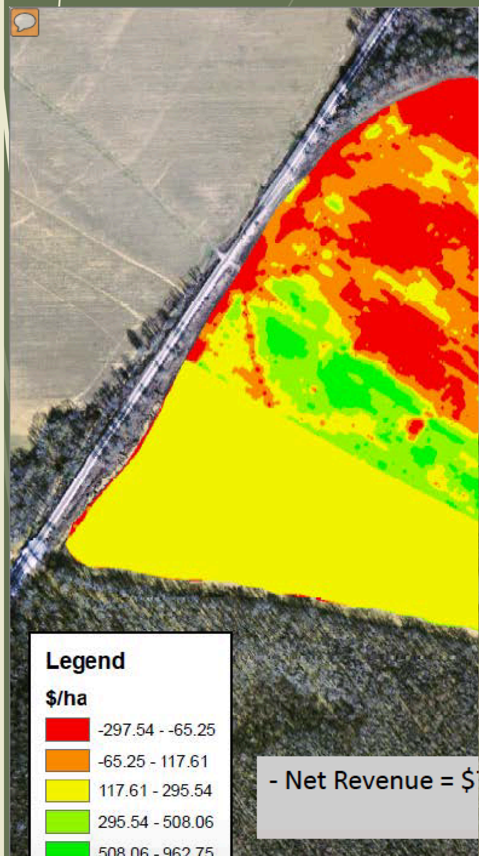
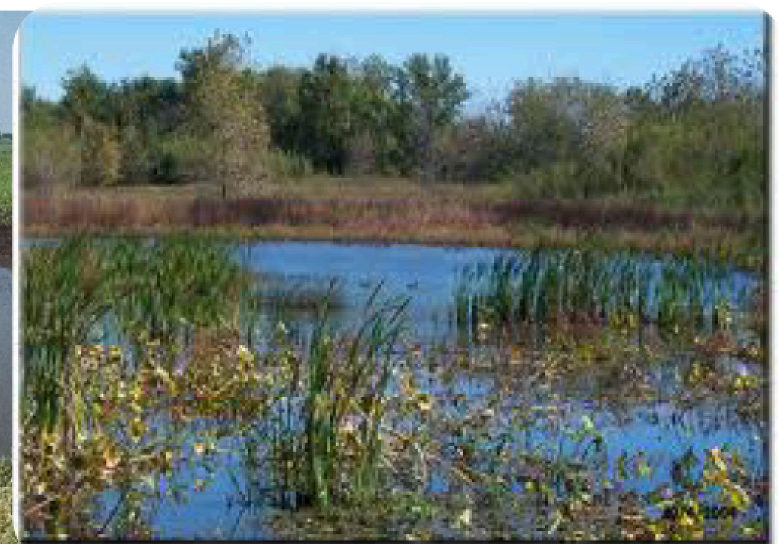


http://www.efcsystems.com/index.php/agronomicplanningandsustainability/

Mississippi State Precision Conservation

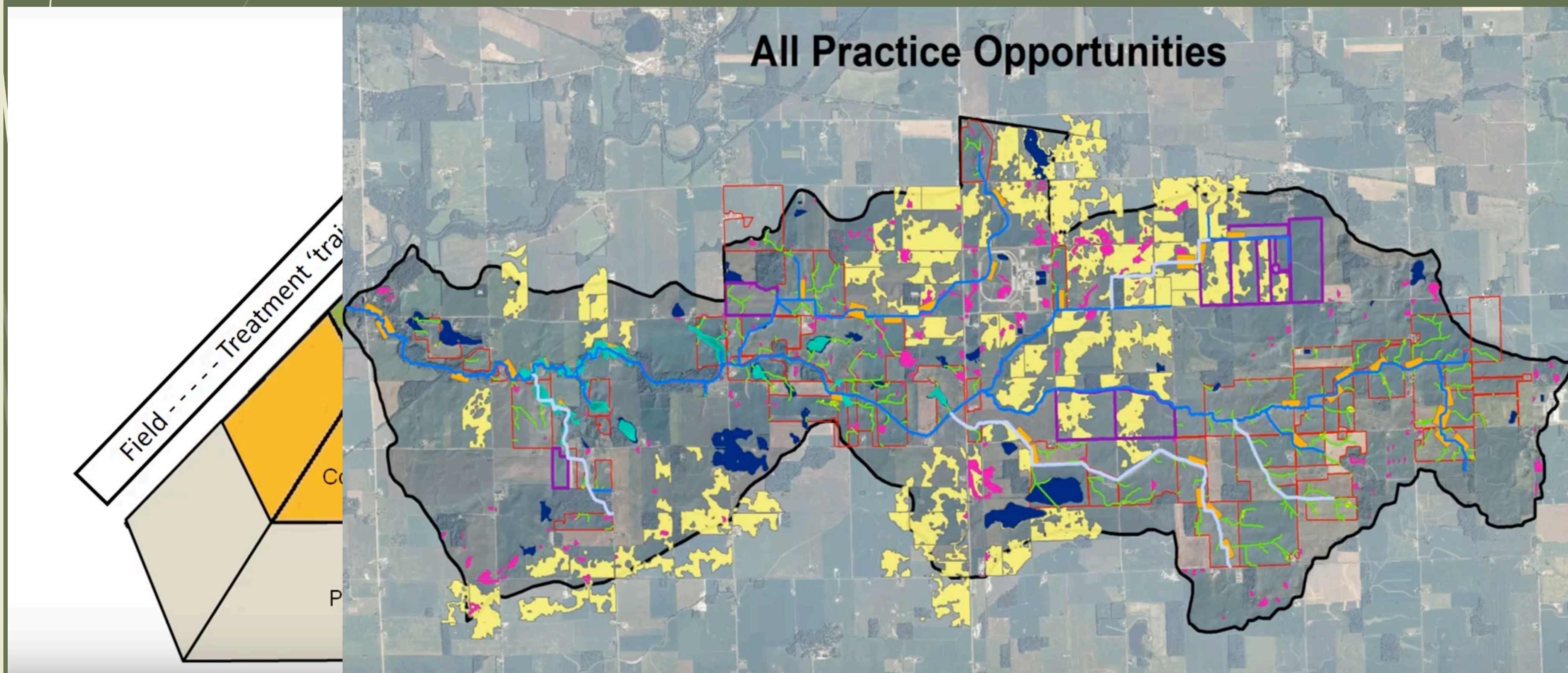


Production Alone	Production + CP 23	Economic Gain
$71.82/acre	$75.39/acre	$3.39/acre



Slides courtesy of Mark McConnell, University of Georgia

Agricultural Conservation Planning Framework



USDA

Slides courtesy of Mark Tomer, USDA ARS

A unified, full scale watershed approach is necessary to achieve water quality and quantity goals

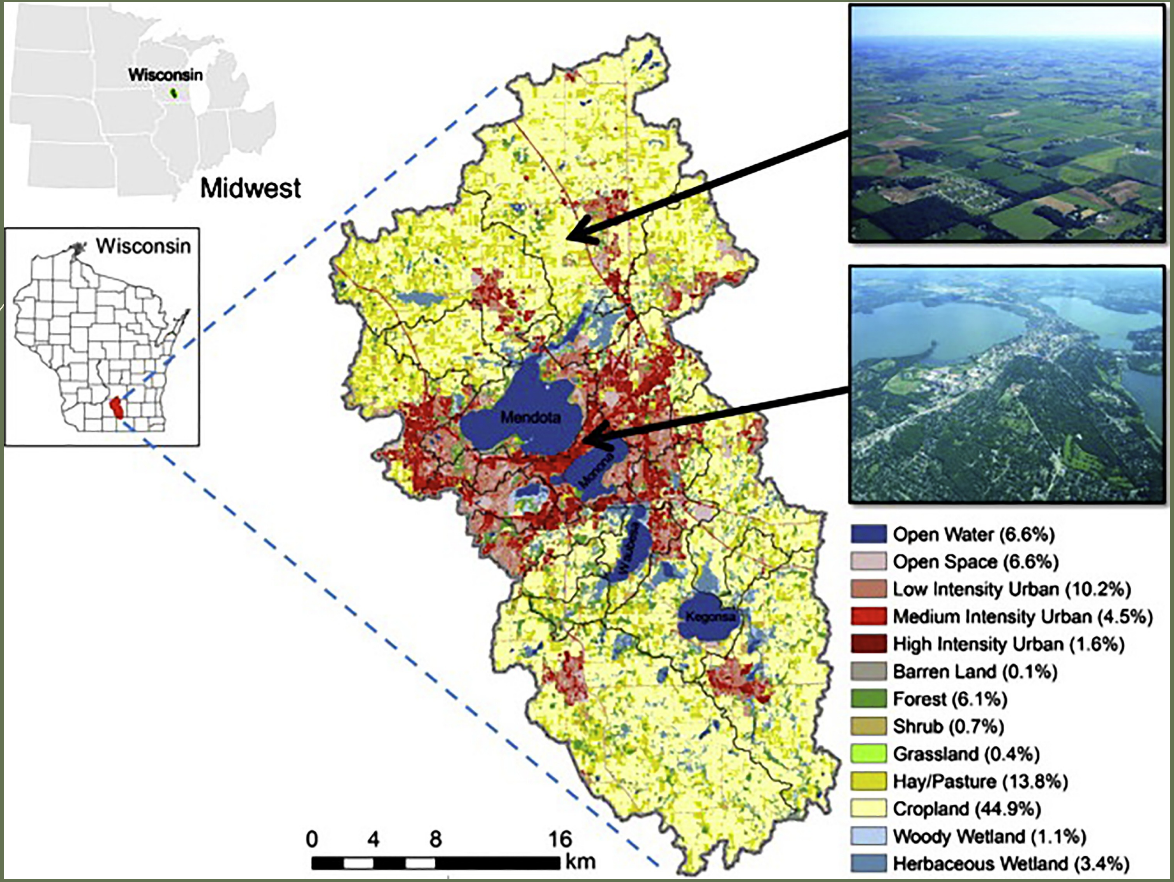
Photo Credit: Michael Thomas

The Watershed Approach

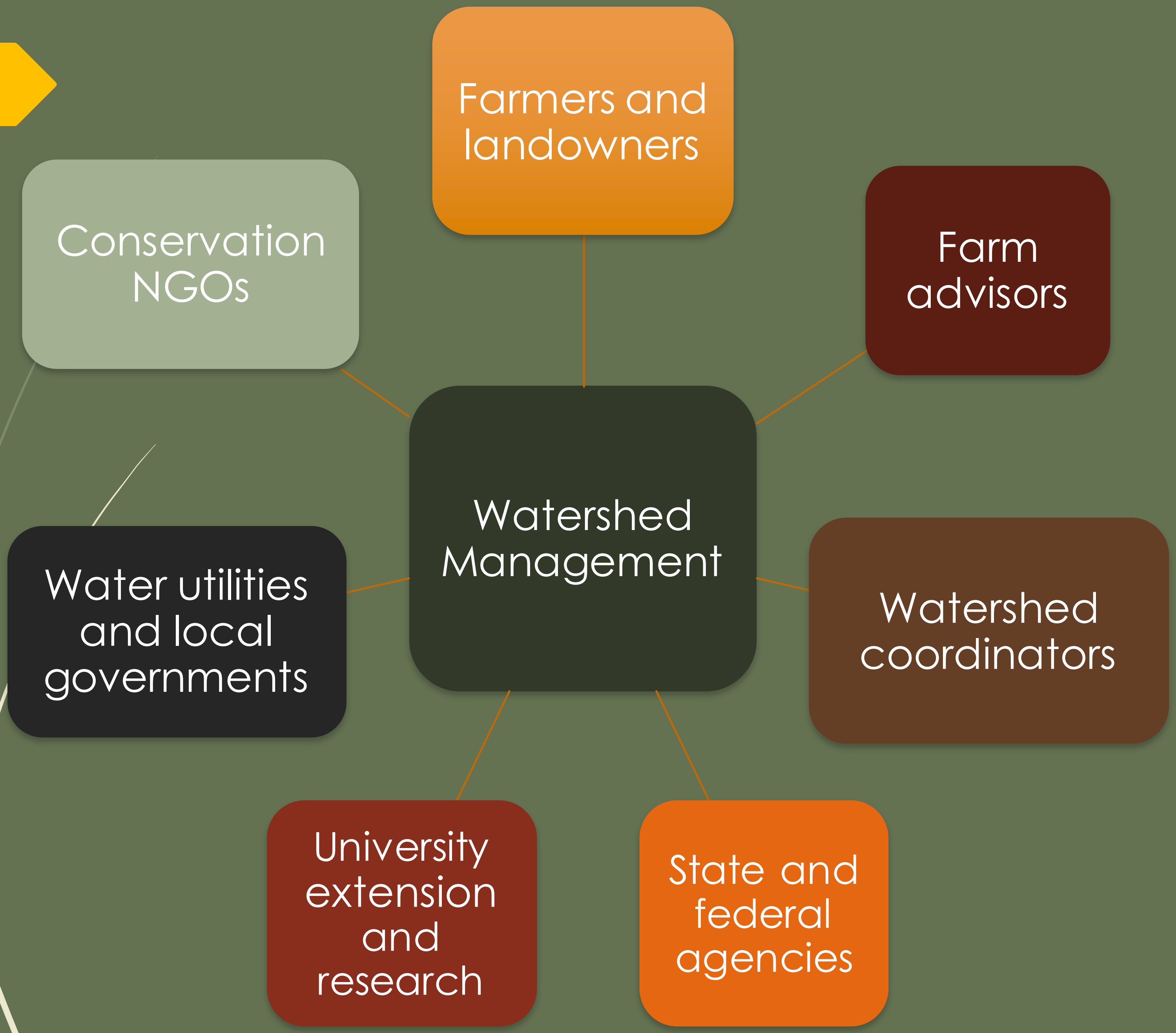
- a systems approach with watersheds as the organizing and analytical unit
- multiple-scale, multiple-objective planning for watersheds and sub-watersheds
- multi-organizational coordination and public participation
- science-based, information driven decisions
- adaptive processes to reflect changing conditions, needs, and new knowledge

Born & Genskow, 1999

Yahara Watershed Adaptive Management



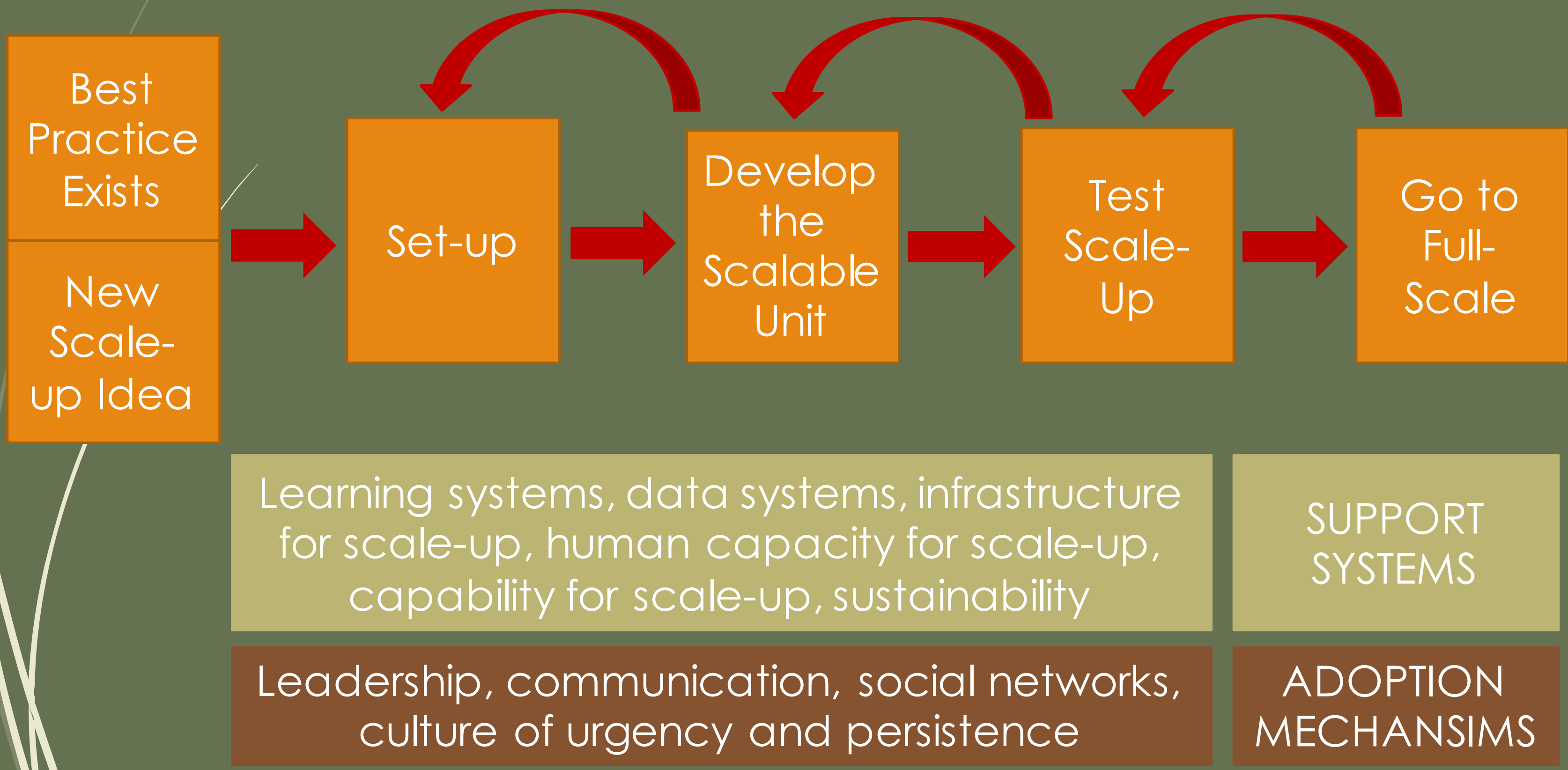
Wardropper, Gillon and Rissman 2016


Farmers and landowners
Conservation NGOs
Farm advisors
Watershed Management
Water utilities and local governments
Watershed coordinators
University extension and research
State and federal agencies

How do we "get to scale"?

- Identify consistent elements of our theory of change
- Determine how to replicate the operating model

Phases of scale-up: a public health model



Barker et al 2016: http://bit.ly/2GKRjod

Theory of change: Necessary elements of successful watershed management?

- Scalable unit
- Human capital
- Social capital
- Watershed financing systems
- Policy and governance systems
- Technology

Scalable unit

- Watershed planning + implementation
- a foundational social network
- This social network often at smaller watershed scales in our region (10,000-40,000 acres, HUC 12)
- Planning can occur at larger scales (HUC 8/10), creating efficiencies

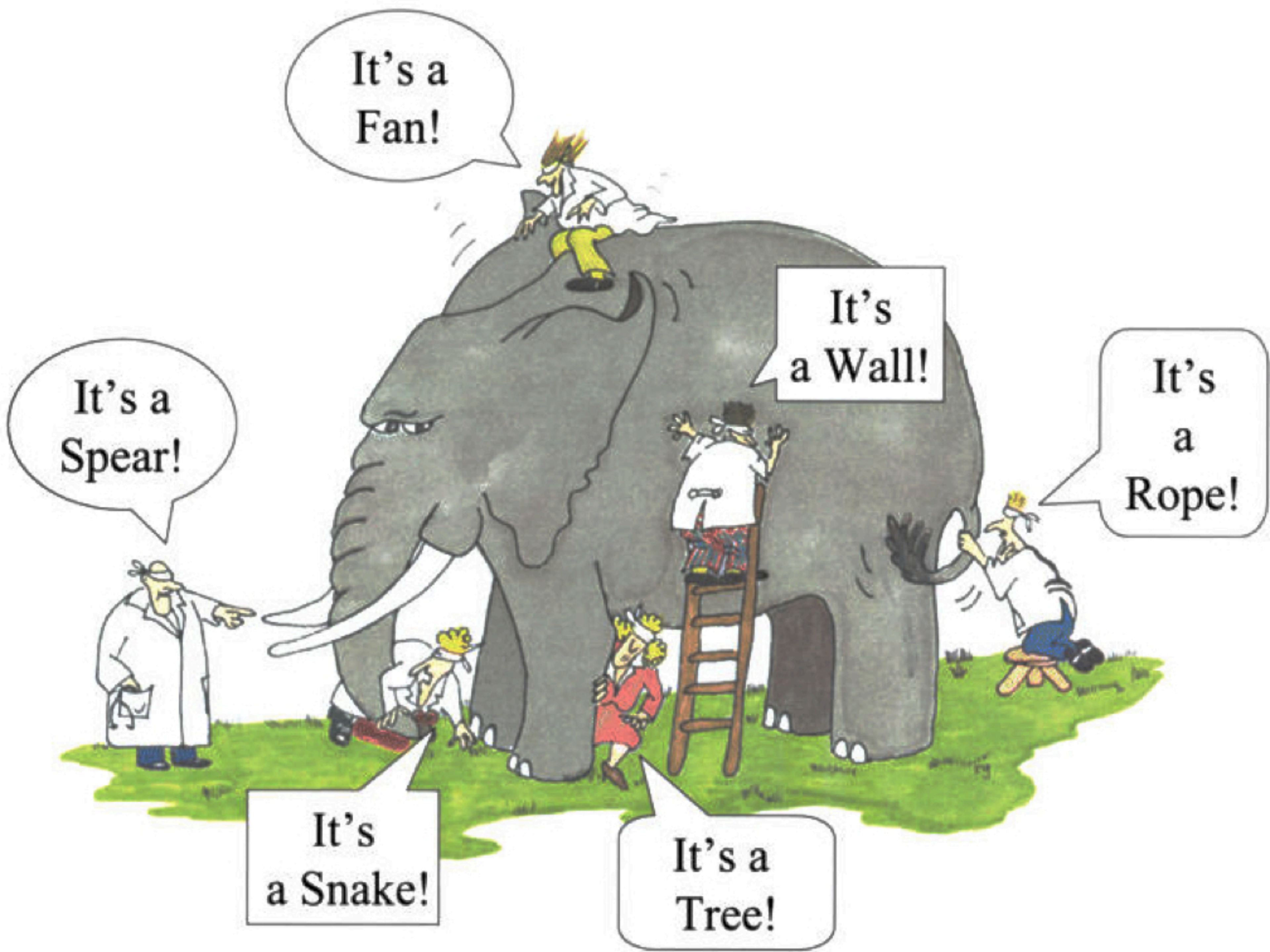
Human capital and workforce development

- Watershed leadership (coordinators, landowners, farmers, farm advisors, water utilities, sewerage districts, citizens)
- Watershed coordinators and support staff
- System integrators, liaisons
- Professionalizing watershed management
- Professional development and certification

Social capital

- Stakeholder (collective) readiness and engagement
- Building trust and relationships
- Active programs for social network development
- Structure for community learning and decision making
- Agreed on goals and managed expectations
- Broader regulations can be a catalyzing factor
- Communication/coordination among state and federal agencies (eg. NRCS)

We need farmer and ag sector leaders more than ever before


It's a Fan!
It's a Spear!
It's a Wall!
It's a Rope!
It's a Snake!
It's a Tree!

Complicated vs Complex

- Complicated
  1. Problem is easily definable
  2. Existing knowledge is sufficient
  3. Can solve with an algorithm, formula or blueprint
  4. Context is stable and outcome is predictable – change can be planned for

Complicated vs. Complex

- Complex
  1. Only parts of the problem are definable
  2. Existing know-how inadequate, context unstable, outcomes unpredictable
  3. Need for constant experimentation and adaptation
  4. Unplanned change is the norm

Farmer and Ag Sector Leadership

Yahara Pride looks to enlist local farmers in the fight against phosphorus runoff

Jessica Van Egeren–The Capital Times

SPRINGFIELD — On a brilliant, sunny but frigid Wisconsin day, Jeff Endres, a fifth-generation farmer, uses a rake to scratch through a foot-and-a-half of snow on his farm just west of Waunakee.

land, it's not bare, frozen g

WHAT'S YOUR STRATEGY?

The Illinois Nutrient Loss Reduction Strategy: Illinois farmers across the state share their conservation stories

BMPs › | Partners › | About › | Calendar

Association (Past President 2012, 2013)

Programs utilized: EQIP

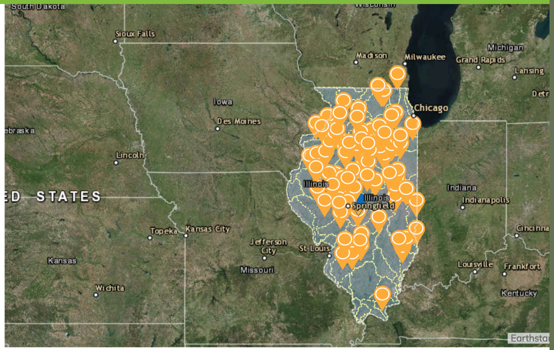
Best Management Practice(s):

- Nutrient Management (e.g. 4'R's, nitrogen inhibitors)

Description: As a fourth generation farmer in Morrisonville, my farm has been in my family for over 100 years. Today, our farm has three wean-to-finish barns. As part of my livestock nutrient management plan, I apply manure with a knifing system, injecting the manure six inches below the ground on approximately 250 acres of farmland. This is an environmentally safe process with no surface run-off. I am also currently participating in a field trial to demonstrate the effect of Instinct II (nitrification inhibitor) on the form of N found in the soil following a manure application. N-WATCH sampling will also be pulled at these sampling sites for side-by-side comparisons.

Contact Info: Dereke Dunkirk:(217) 820-0117

Website: http://www.ilpork.org



Partnership and Collaboration: the Key to a One Water future in Iowa

Iowa strives to take a "watershed approach" from an organizing principle to action.

Nick Meier, a farmer in the Middle Cedar Watershed, is implementing a variety of conservation practices on his farm.

Building Capacity for Watershed Leadership

WISCONSIN
UNIVERSITY OF WISCONSIN–MADISON

University of Kentucky

THE OHIO STATE UNIVERSITY

IOWA STATE UNIVERSITY

UNIVERSITY OF ARKANSAS

Funding provides by US Environmental Protection Agency

Questions?