



CABBI

CENTER FOR ADVANCED BIOENERGY
AND BIOPRODUCTS INNOVATION

Emily Heaton
Feedstock Production Theme Lead
Sustainability Theme member

The promise of purpose- grown energy crops

DOE BETO Purpose-Grown Energy
Crop Workshop

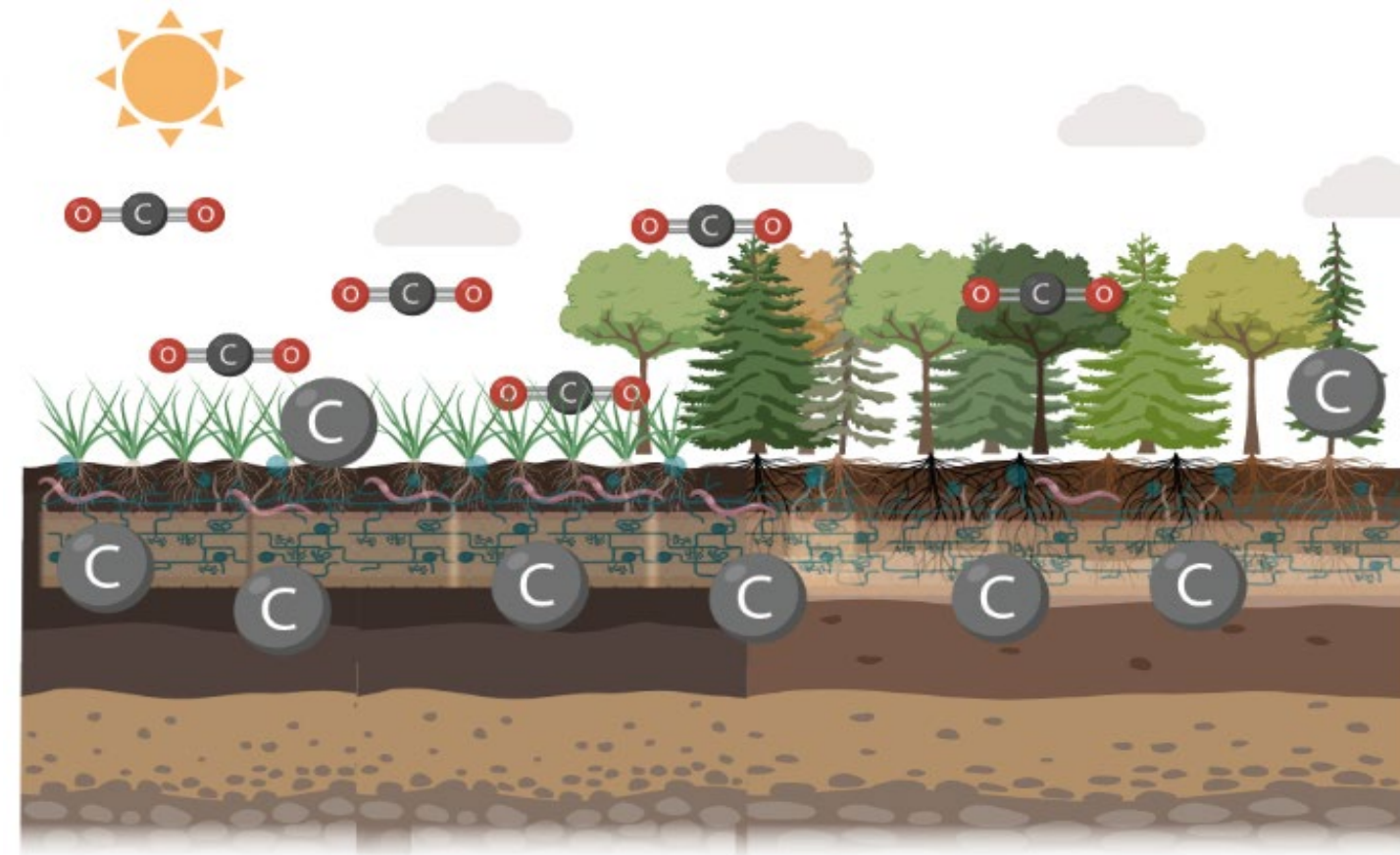
Kansas City, June 6-7 2023





Why are energy crops of interest?

1. Plants are THE major mechanism CO₂ is removed from the air
2. Putting 15% of cropland into perennial grasses solves >90% of ag's environmental problems and saves (makes) money



Prairie as Proxy – The Prairie Strips Project





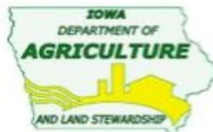
www.prairiestrips.org

prairiestrips@iastate.edu

[@prairiestrips](https://twitter.com/prairiestrips)

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

College of
Agriculture &
Life Sciences



McIntire-Stennis
Program



Committee on
Agricultural
Development



CORTEVA[™]
agriscience

Smithfield

syngenta
Global



MICHIGAN STATE

Prairie strips improve corn-soybean croplands*



Site: Interim 1
Crop: 90%
Prairie: 10% in multiple contour strips
Catchment size: 3.00 ha
Catchment slope: 7.7%

Site: Interim 2
Crop: 90%
Prairie: 10% at footslope
Catchment size: 3.19 ha
Catchment slope: 6.1%

Interim 3
Crop: 100%
Prairie: 0%
Catchment size: 0.73 ha
Catchment slope: 9.3%



*Schulte et al., (2017)
Proceedings of the National
Academy of Sciences
114 (42) 11247-11252;



100% crops



90% crops:
10% prairie



100% prairie



Images: Jose Gutierrez

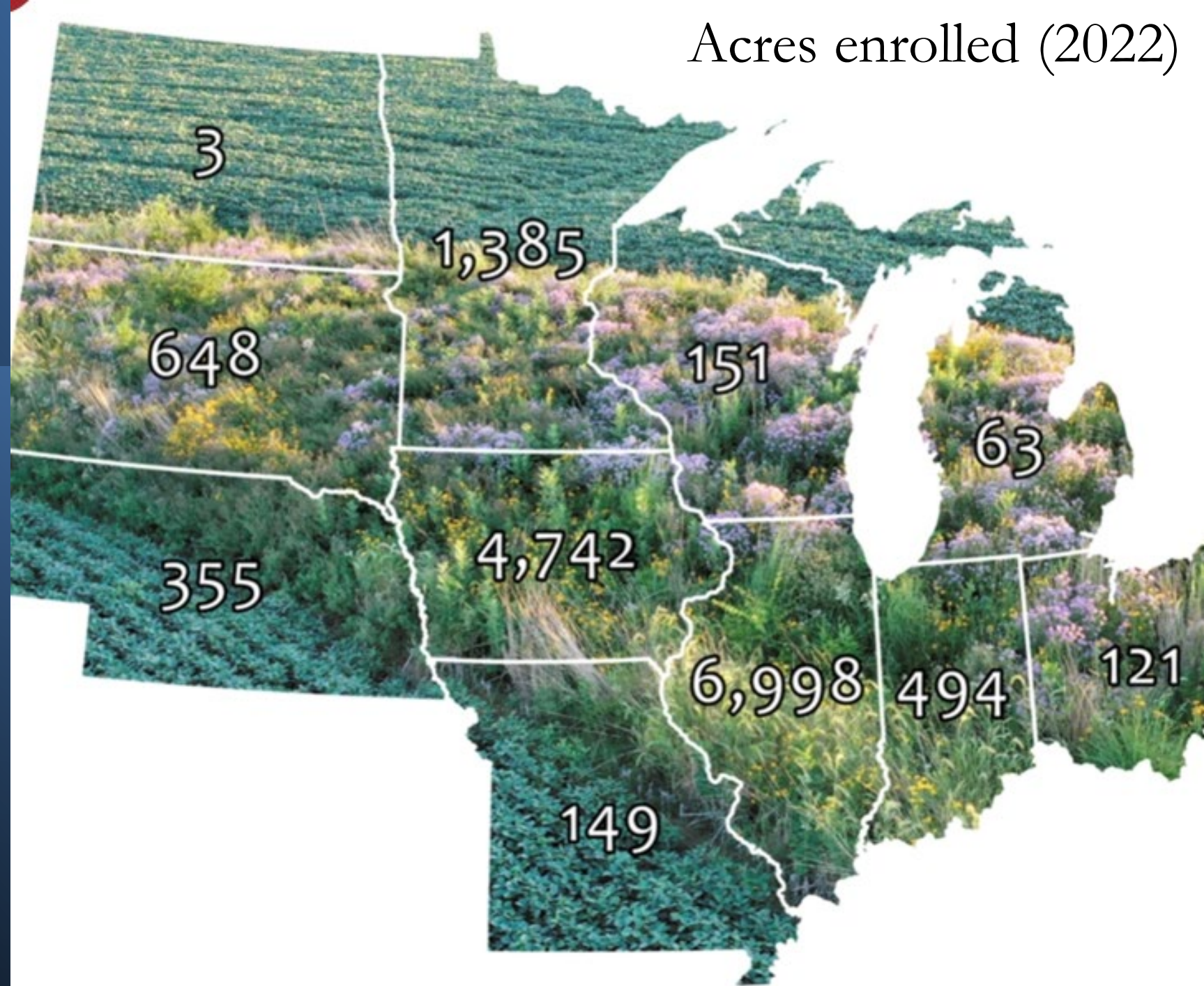


Strategically incorporating **~10% prairie** into annual row crop fields leads to...

- 1 44% reduction in water runoff
- 2 95% reduction in soil loss through runoff
- 3 90% reduction in phosphorus runoff
- 4 84% reduction in nitrogen runoff and 70% reduction in subsurface nitrate loss (not tiled)
- 5 2-3 times more beneficial insects and birds
- 6 No reduction in per acre yields
- 7 Costs less than terraces; comparable to cover crops



Prairie Strips
added as
conservation
practice in
2018 Farm
Bill (CP43)



**“THERE’S LOTS OF
REASONS TO GROW
PERENNIALS, BUT
MONEY ISN’T ONE OF
THEM”
- ME, 2015**



INVITED RESEARCH REVIEW | Open Access |

Redefining marginal land for bioenergy crop production

Madhu Khanna , Luoye Chen, Bruno Basso, Ximing Cai, John L. Field, Kaiyu Guan, Chongya Jiang, Tyler J. Lark, Tom L. Richard, Seth A. Spawn-Lee, Pan Yang, Katherine Y. Zipp



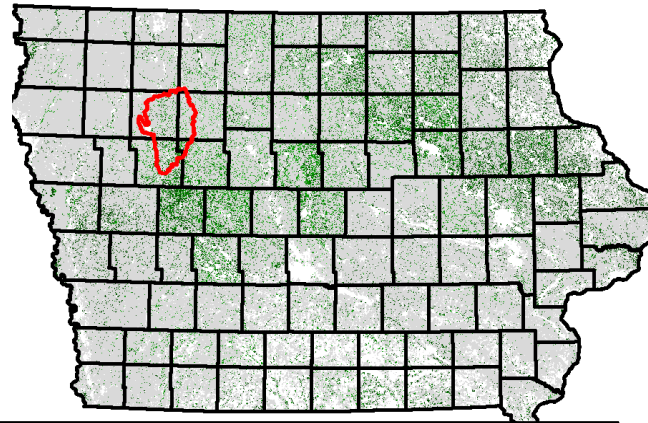
Corn???

Miscanthus



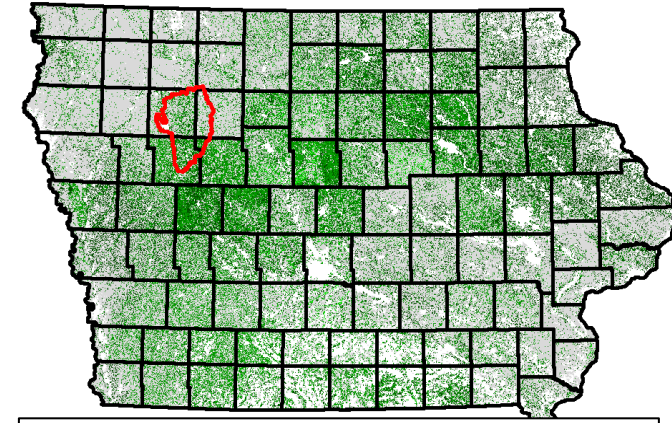
Integrating
perennials on
unprofitable
parts of fields
can
meaningfully
increase
profitability
and retain N

Conservative Scenario

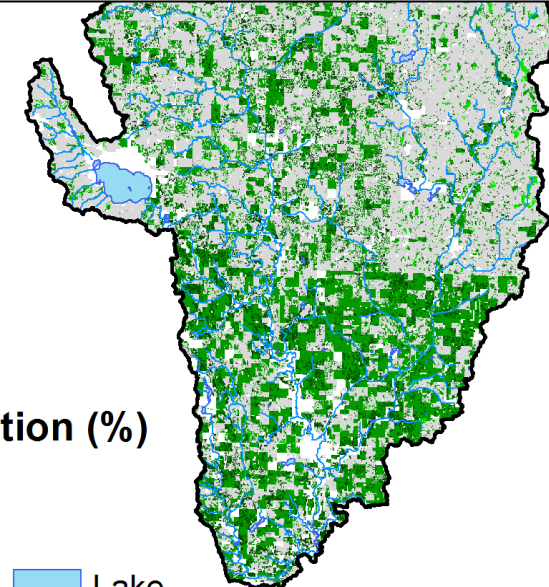
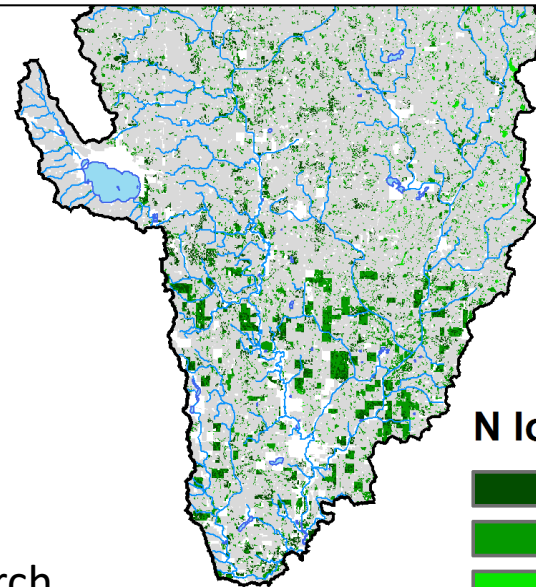


Converting to switchgrass
areas that **lose > US\$ 100 ha⁻¹**
and **leach > 50 kg N ha⁻¹**
reduces statewide N loss 18%

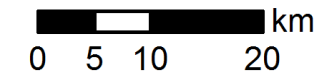
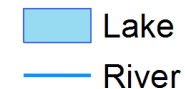
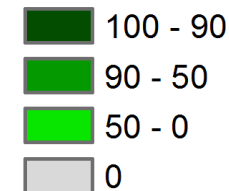
Nutrient Reduction Scenario



Converting to switchgrass
areas that **lose > US\$ 0 ha⁻¹**
and **leach > 20 kg N ha⁻¹**
reduces statewide N loss 38%

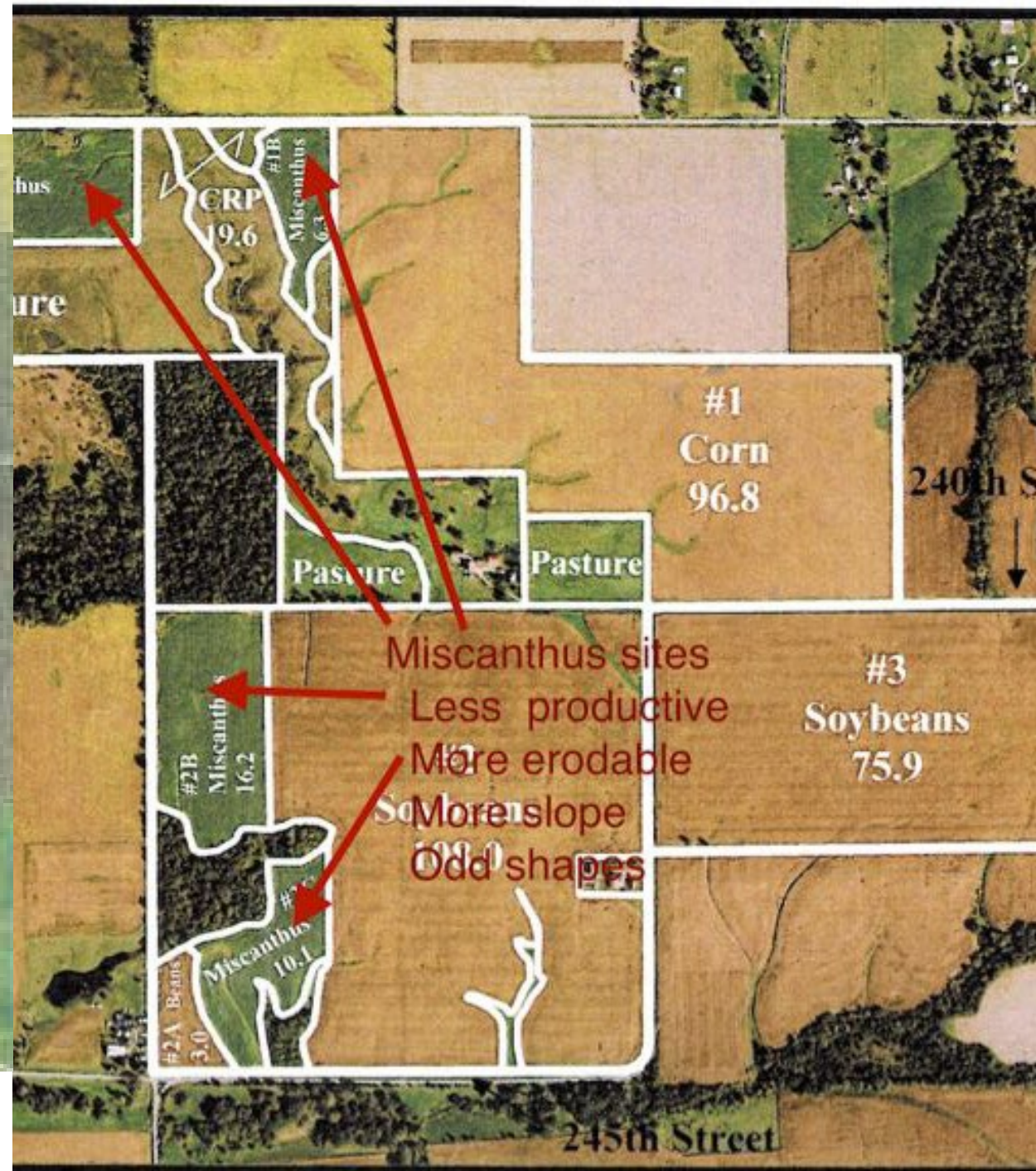
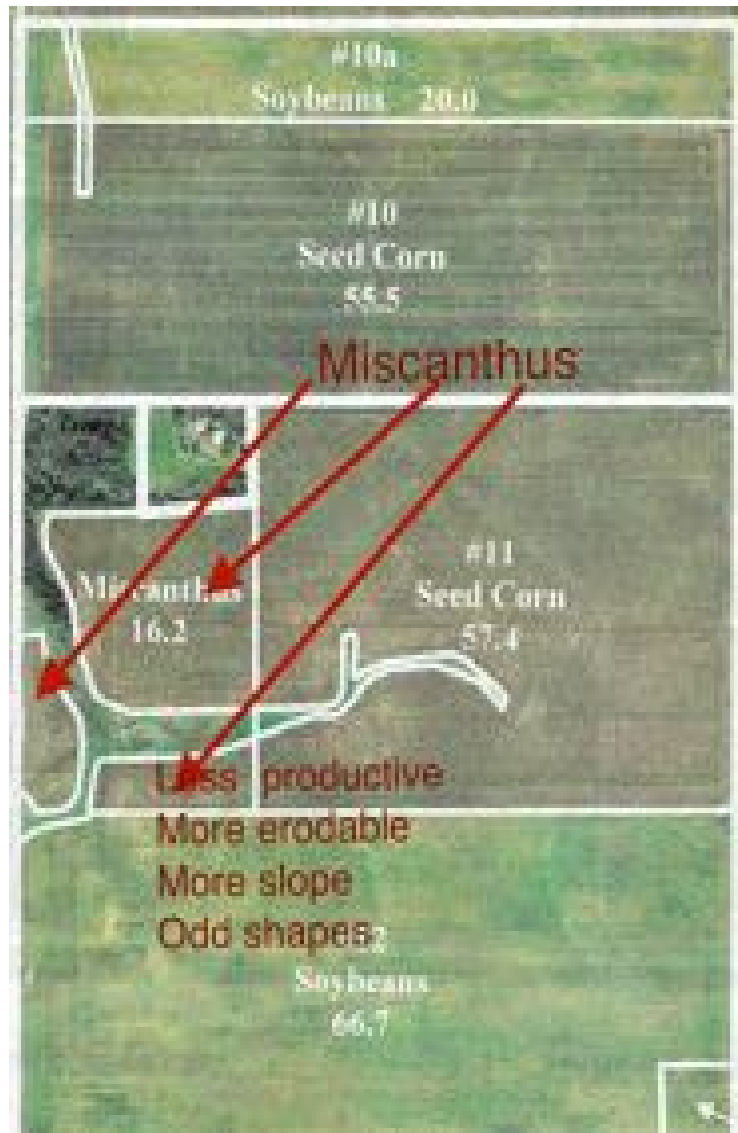


N loss reduction (%)





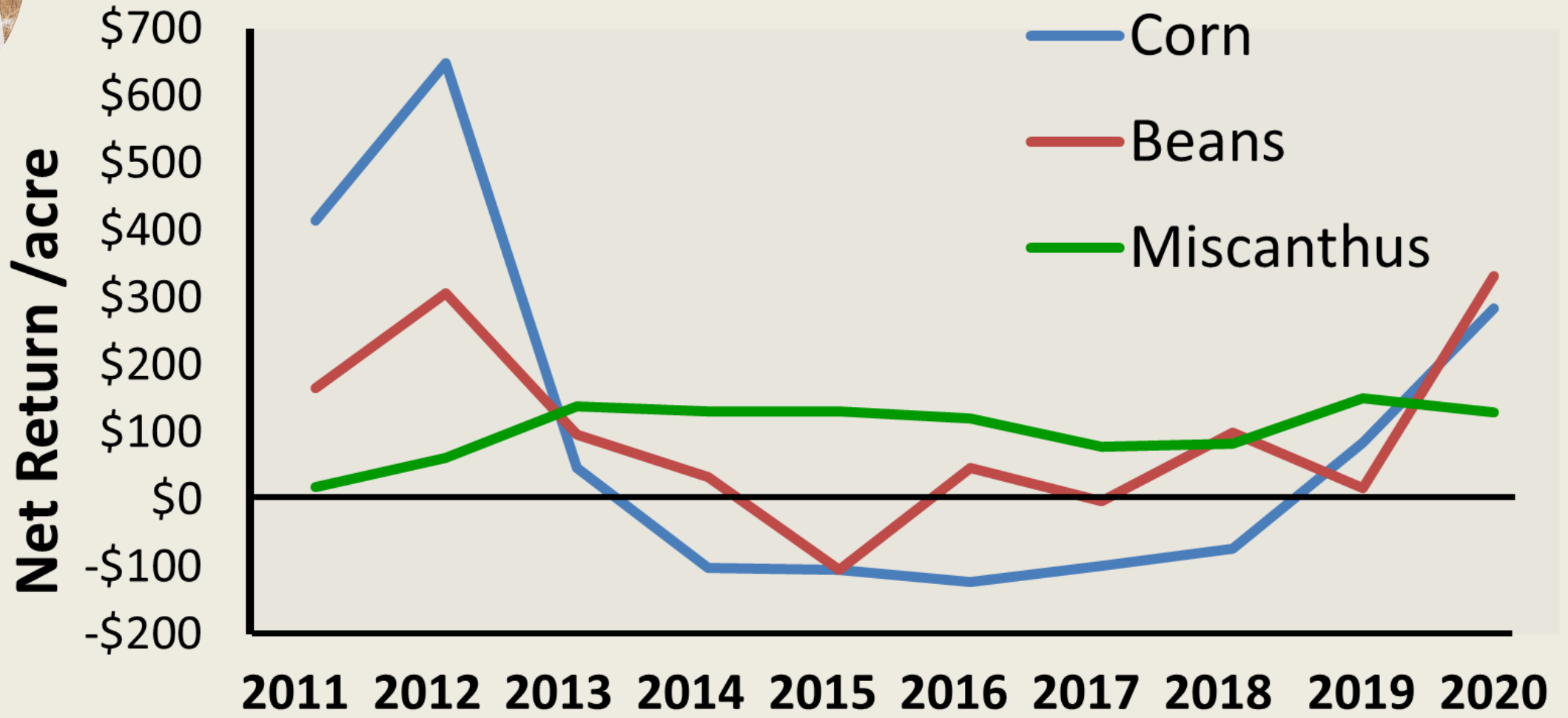
Steve Schomberg – Schomberg and Meeker Farms, Iowa City, IA area



Slide courtesy of Schomberg/Meeker Ag Farms



Long Term Economic Comparison

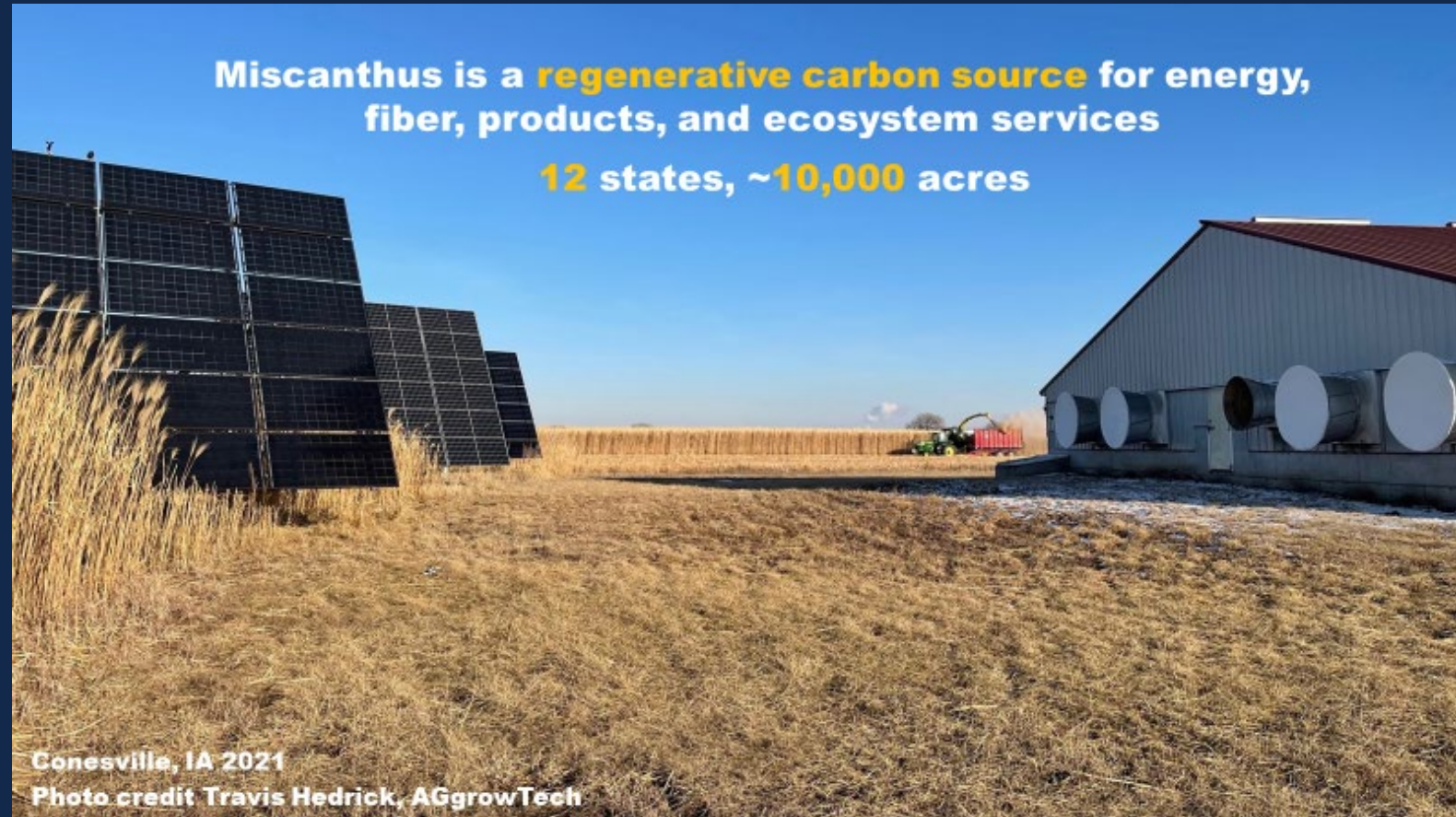


Data courtesy Eric Rund, Pesotum, IL

Integrated land management

Biomass crops are increasingly valuable for integrating soils, crops, livestock, and people

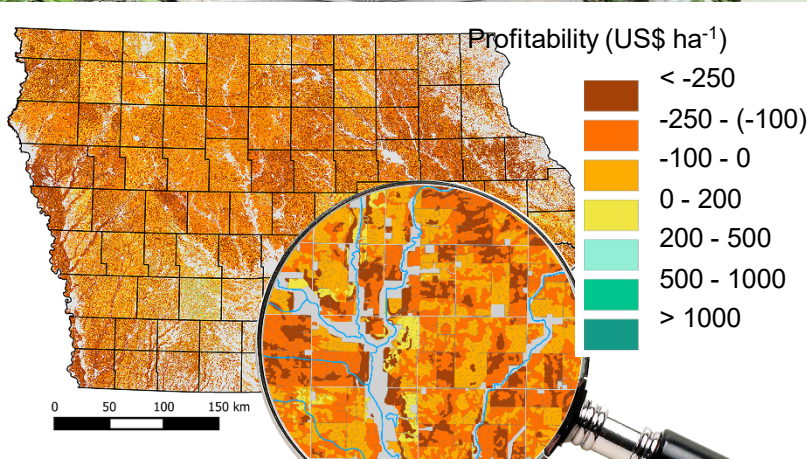
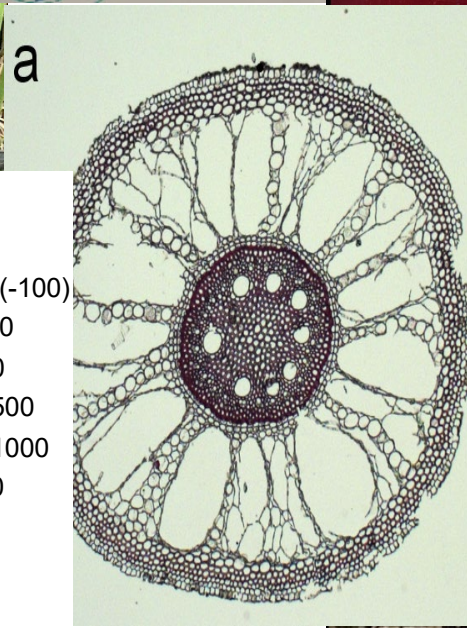
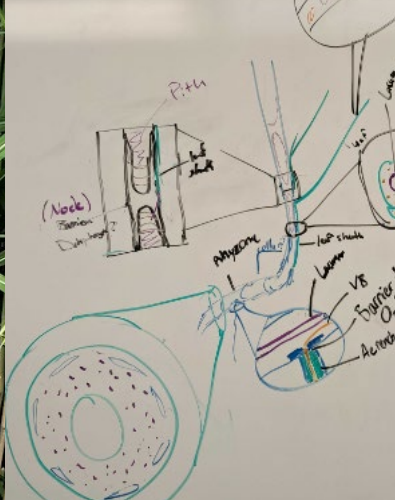
- Bedding
- Soil amendments
- Solar farms
- Plastic replacements
- Fiber
- Feed, fiber or oil “cover” crops



Questions?

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<https://scholar.google.com>; search Emily Heaton



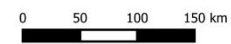
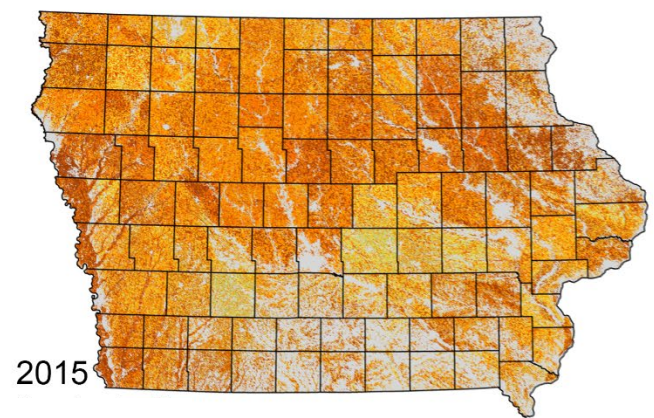
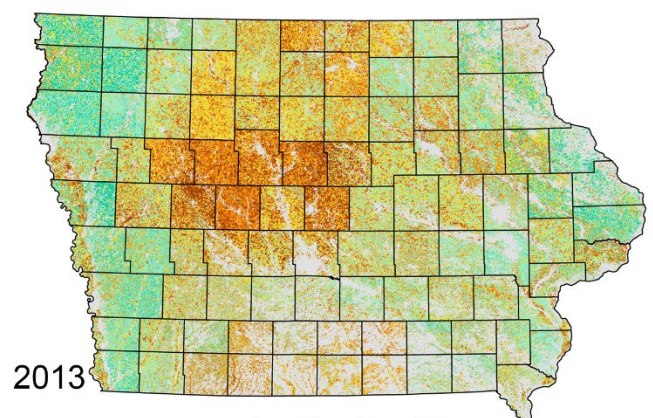
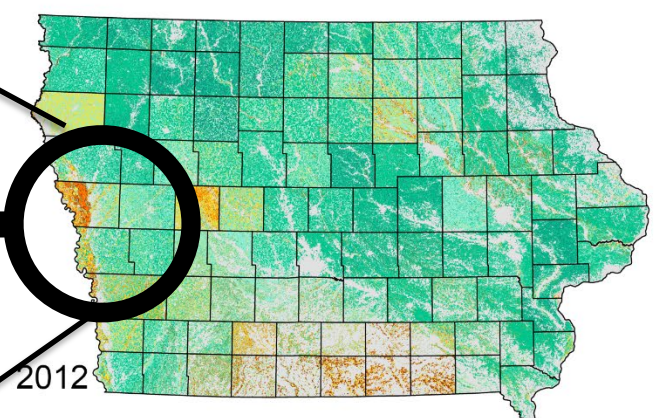
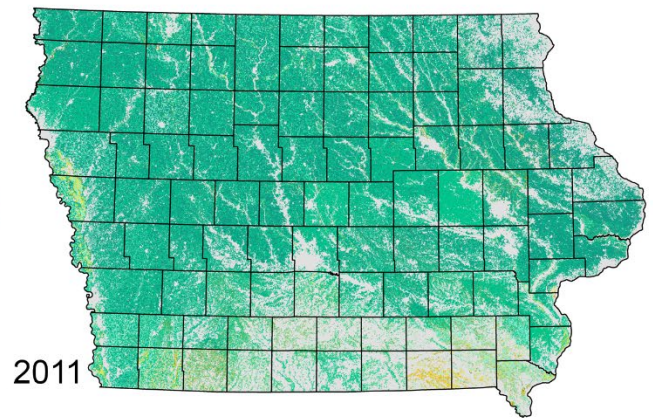
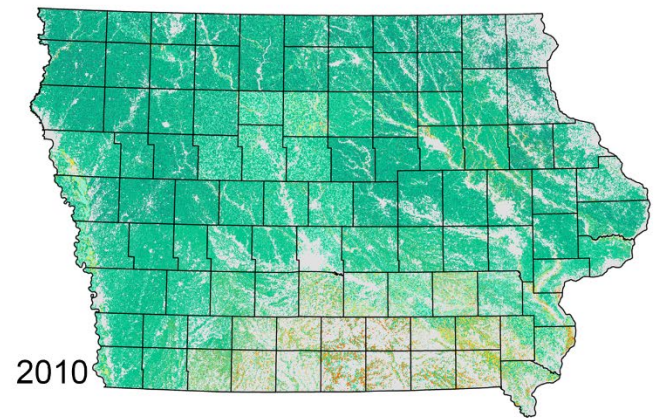
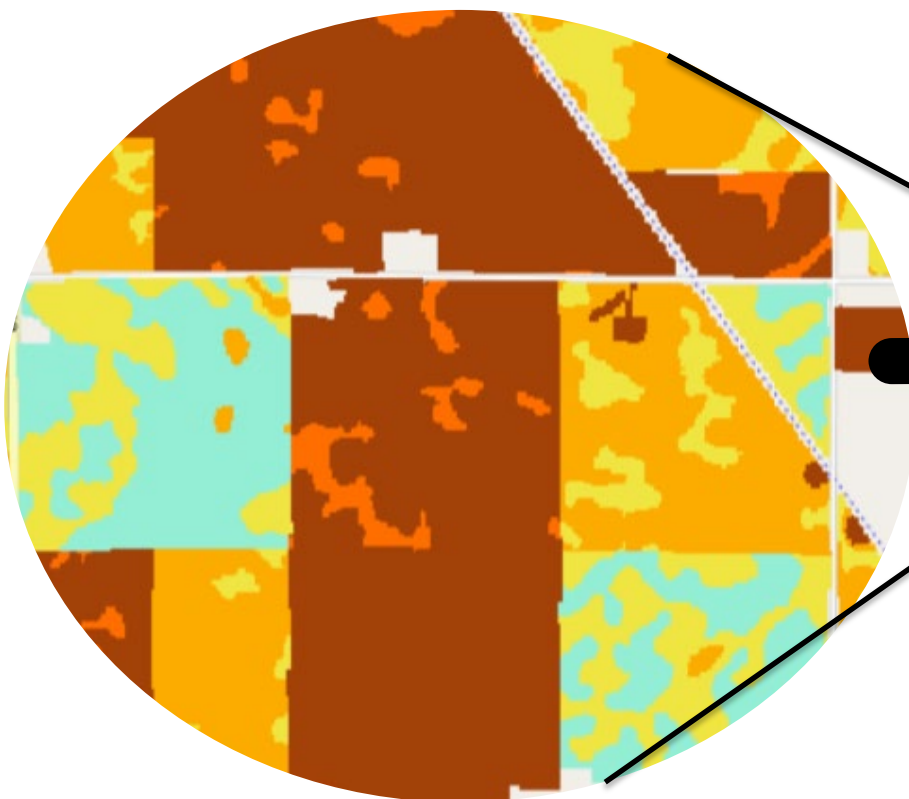
Caveny Farm, Monticello, IL

photo credit: Tim Higham








Some parts of fields are less profitable than others.

Zoom in to learn more at:
<http://mesonet.agron.iastate.edu/GIS/apps/profit/>



Profitability (US\$ ha-1)

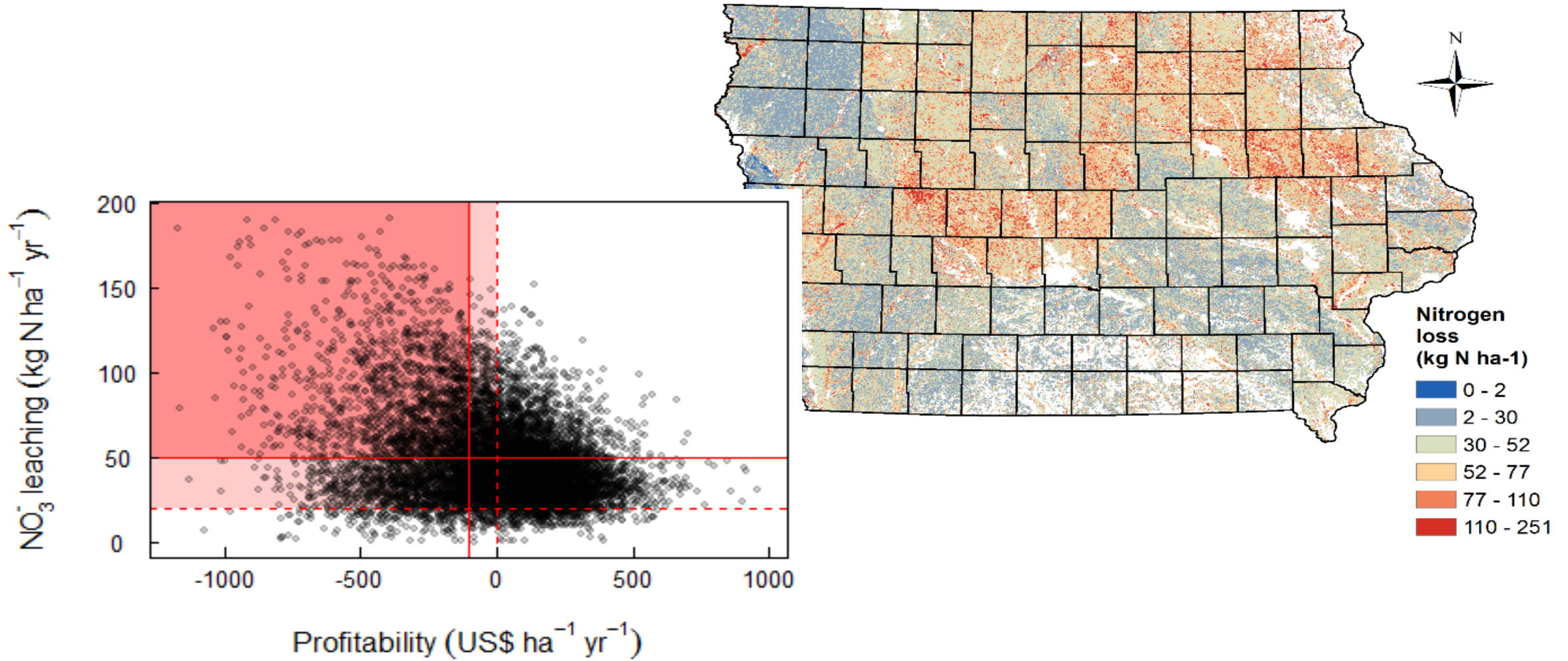
-  < -250
-  -250 - -100
-  -100 - 0
-  0 - 200
-  > 200



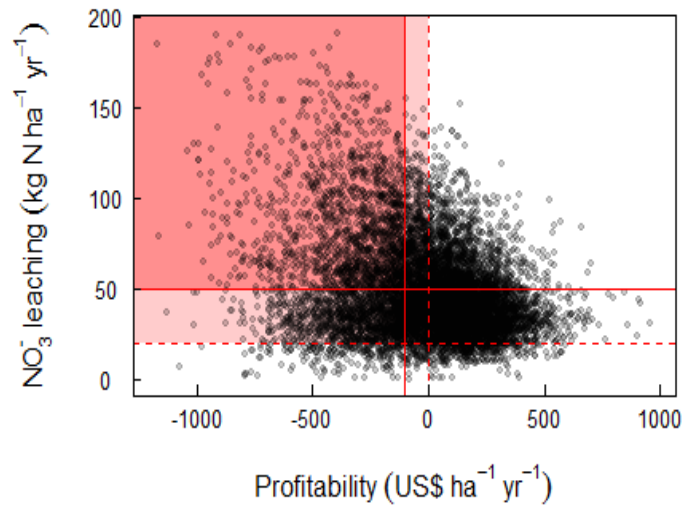
[View Disclaimer](#)

Brandes E, McNunn GS, Schulte LA, Bonner IJ, Muth DJ, Babcock BA, Sharma B, Heaton EA (2016) Subfield profitability analysis reveals an economic case for cropland diversification. *Environmental Research Letters*, **11**, 014009.

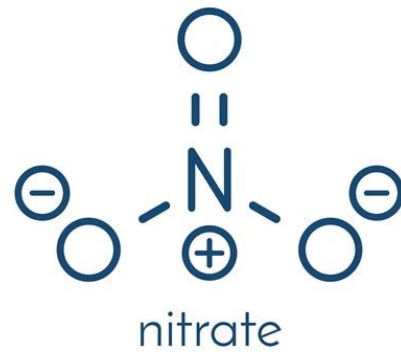
Nitrogen and profit loss often coincide in corn/soy fields



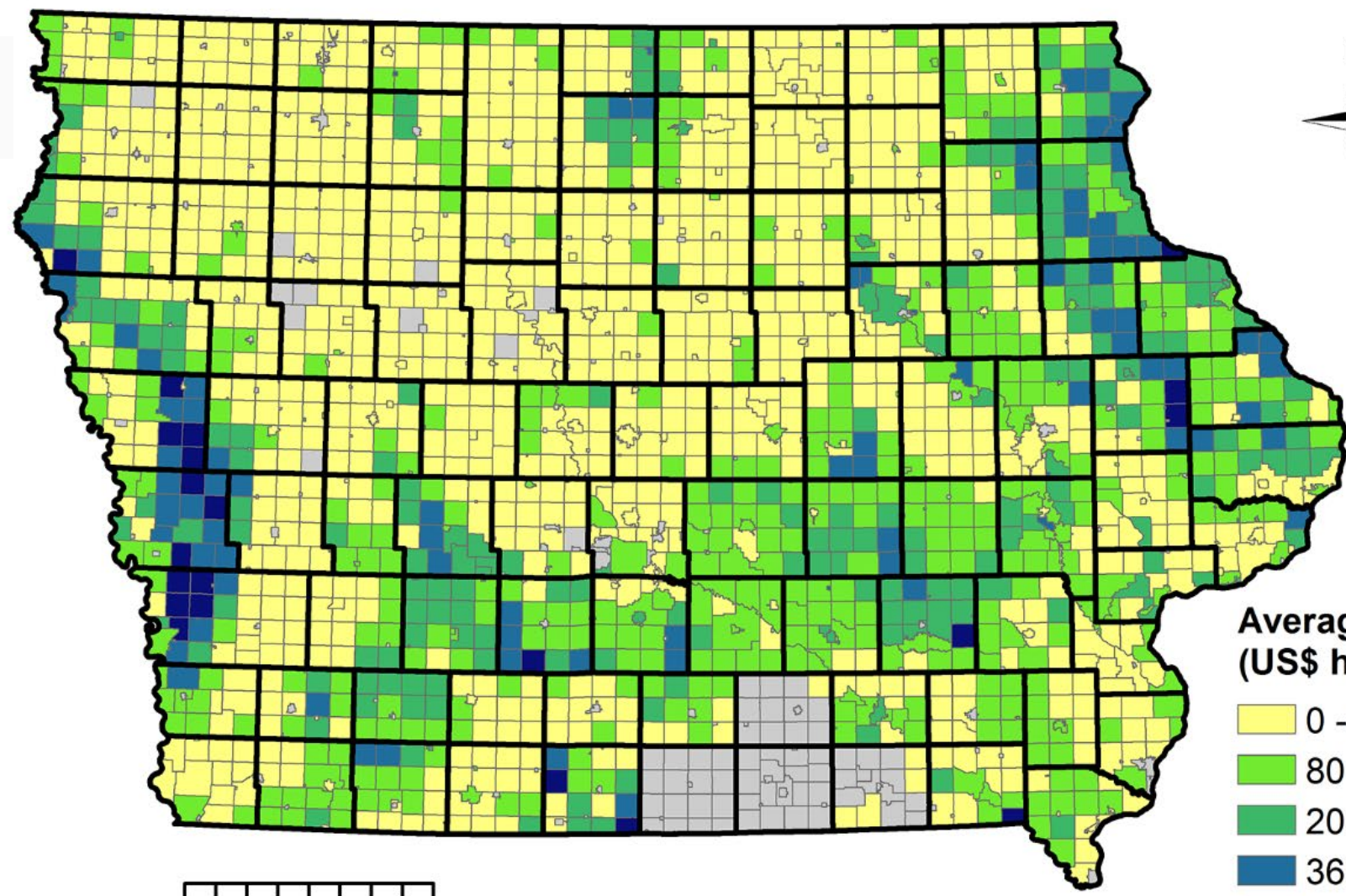
Subfield-scale NO₃-N leaching on corn/soy cropland. Values are annual rates averaged over the years 2012-2015. Brandes, McNunn, Schulte, Muth, VanLoocke & Heaton (2018) Global Change Biology Bioenergy



What if we grew perennial plants in “leaky” parts of corn/soy fields?



Subfield-scale NO_3^- -N leaching on corn/soy cropland. Values are annual rates averaged over the years 2012-2015. Brandes, McNunn, Schulte, Muth, VanLoocke & Heaton (2018) *Global Change Biology Bioenergy*



Increase in state-wide total producer benefit over 10 years ~\$130M (\$2 -\$218M across 18 sensitivity scenarios).

Average change in NPV (US\$ ha-1)

- 0 - 80
- 80 - 200
- 200 - 360
- 360 - 670
- 670 - 1554
- No viable cropland

0 25 50 100 km



ECONOMICS OF CROPS GROWN ON OUR FARM – ERIC RUND

DECEMBER 31, 2020



	Corn	Soybeans	Miscanthus
Yield bu or dry tons/acre	230	70	7.5
Price/bu - ton, Farm Gate	\$ 4.75	\$ 13.08	\$ 90
Government Paments	\$ 90	\$ 98	
Income	\$ 1,183	\$ 1,014	\$ 675
Fertilizer	\$ 139	\$ 59	\$ 39
Chemical	\$ 63	\$ 71	\$ -
Seed	\$ 133	\$ 64	\$ -
Power, Equip	\$ 122	\$ 98	\$ 106
Strg, Drying, Bldg	\$ 62	\$ 26	\$ 133
Labor paid and unpaid	\$ 56	\$ 56	\$ 25
Misc,Ins, Interest	\$ 64	\$ 48	\$ 23
Land Rent	\$ 260	\$ 260	\$ 220
Expense	\$ 899	\$ 682	\$ 546
NET / ACRE	\$ 284	\$ 332	\$ 129