U.S. Department of Energy (DOE)
Bioenergy Technologies Office (BETO)
2017 Project Peer Review

WBS 4.2.2.10: Biomass Production and Nitrogen Recovery

March 9, 2017
Technology Area: Sustainability

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Organization: Argonne National Laboratory

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Goal Statement

Bolster the cost competitiveness of bioenergy – support the Billion Ton vision through the assessment and valuation of concurrent ecosystem services (ES)

- Obtain primary performance data from field trial on water quality, soil quality, GHG emissions, water use, biodiversity
- Conduct watershed analysis to understand potential benefits at implementable scale
- Understand cost competitiveness of bioenergy compared to other conservation practices, and markets for ES
- Engage in stakeholder involvement to ground solutions in real world.

Project supports BETO's sustainability platform goal (Sustainable system design) of validating case studies of feedstock production systems by 2018.

COMPLEMENTS MODELING AND ANALYSIS WITH FIELD BASED EVALUATION AND PRIMARY DATA COLLECTION.

Outcomes:

- **Field data** on sustainability metrics, yields and environmental impacts of landscape-placed bioenergy crops, **methods to test best practices** for sustainable bioenergy production
- Provides a **methodology for a system-level assessment** at the farm scale, to be scaled to watershed and region in the future, including physical modeling, lifecycle analysis, and techno-economic analysis of landscape practices.
- Provide farmers with a **value proposition** for integrating bioenergy landscapes with their current system.
- Connecting with existing watershed conservation efforts, builds the network to secure implementation in the longer term, provide visibility, access, **feedback from multiple stakeholders to build the basis for bioeconomy.**

Quad Chart Overview

Timeline

- Project start date: 10/2017
- Project end date: 09/2019
- Percent complete: 10%
- Continues from previous project cycle started in FY12

Budget

	FY15-16 Costs	FY17 Costs	FY18 Costs	FY19 Costs
DOE Funded	$1140K	$630K	$620K	$620K
Project Cost Share	n/a	n/a	n/a	n/a

Barriers

Feedstocks

Ft-B: Production

Sustainability

St-E: Best Practices for Sustainable Bioenergy Production

St-F: System approach to Bioenergy Sustainability

St-G: Land Use and Innovative Landscape Design

Partners

Interactions/collaborations

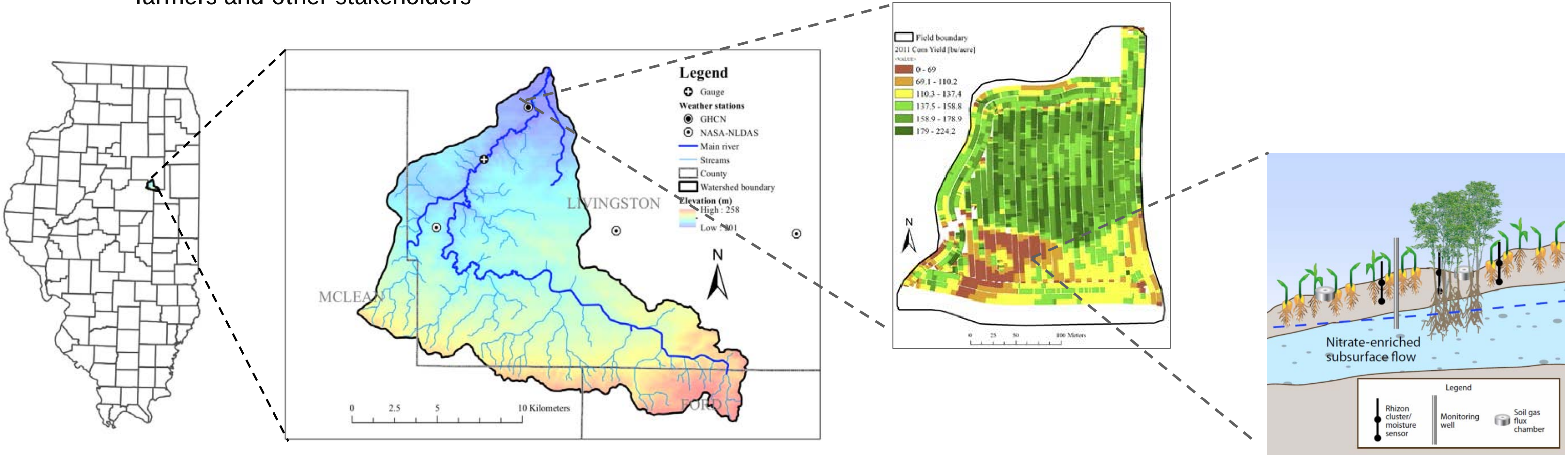
- University of Michigan, Southern Illinois University, UIUC.
- State University of New York/ ESF
- Idaho National Laboratory
- Oak Ridge National Laboratory
- Applied GeoSolutions
- UIUC, UIUC Extension

Non-technical partners

- Livingston County SWCD and NRCS
- Conservation Technology Information Center
- Greenleaf Communities
- Chip Energy

1 - Project Overview

- Designing "How to deploy bioenergy" to also produce environmental services, scaling up from farm to watershed
- Leverages strengths of advanced bioenergy crops to address concerns with current agricultural system through holistic resource management
- Provides a different economic envelope including both yield and ecosystem services and compares to current conservation alternatives – improves cost competitiveness of bioenergy
  - Proof of concept in 2010 led to a field study (ongoing) on nitrogen recovery by bioenergy crop buffer
  - Field study led to a case study in the Indian Creek watershed (ongoing) inclusive of modeling and outreach to community of farmers and other stakeholders



2 - Management Approach - Success factors and progress measurement

Critical success factors:

- Cost-effectiveness of data collection
- Identify value to farmers and other stakeholders
- Identification of viable end use markets for biomass and for ES
- Identification of acceptable economic conditions

Progress measurement:

- Quality and extensiveness of field data collection, QA/QC
- Milestone and deliverable tracking
- Go/No-go decision points to redirect and assess project direction.
- Monthly, quarterly reporting
- Periodic team meetings including collaborators.

Tasks:

Task 1 – Field study

Task 2 – Small watershed modeling

2 - Management Approach - Team members roles

- **Argonne** (0.6 FTE/yr PI, 0.9 FTE/yr PostDoc, 1.5 FTE/yr Field and Lab management)
  - Project leadership
    - Field study
    - Watershed modeling
  - Communications and Project Management
    - Applied Geosciences: modeling support
    - Andrews Engineering: field operations support

- University of Michigan: pollinator modeling, farmer acceptance
- Southern Illinois University: Ecosystem services valuation/economics
- State University of New York/ESF: Willow technical assistance, willow economics
- INL: Logistics analysis, biomass analysis and testing, Hypoxia workshop collaboration
- Chip Energy: biomass use
- NRCS, SWCD, CTIC and UIUC Extension: farmer engagement support
- Greenleaf Communities: NRCS inclusion process study.
- ORNL: Hypoxia Workshop collaboration
- UIUC: collaborative method development for additional sites.

2 - Technical Approach

Proof of concept (FY11)

Field study (FY12-19)

Measure yield and environmental indicators

Small watershed modeling (FY13-18)

- Identify “marginal” land
- Target for bioenergy design (FY14-16), Analyze impact
- Develop Improved Design (FY17)
- Conduct TEA (FY16-17) and LCA (FY17) based on watershed model and field data
- Develop ES quantification and valuation

Determine Pathway for conservation practice

Pursue approval by NRCS

Develop system framework and scale up to region (FY18-19)

Develop Observatory network

Metrics:

- Target: Achieve 30% N-NO_3 reductions in field study - based on current knowledge (Smith et al., 2013*)
- Go/No-go Decision Points:
  - FY15 - based on growth, propose an additional year of project
  - FY16 – Assess completeness of field data and plan for additional collection as needed
  - FY17 – A clear procedure for identification of biomass as conservation practice is found.

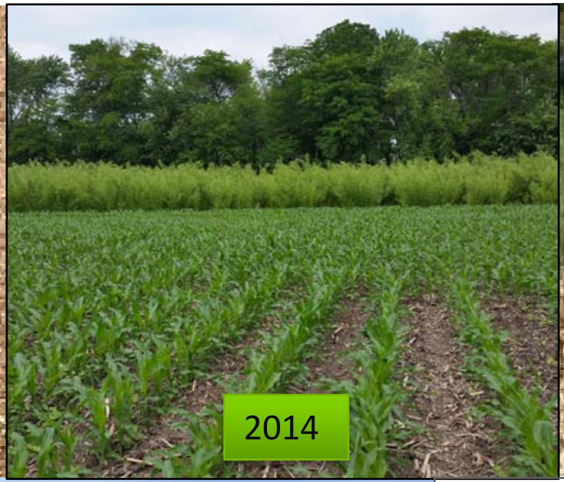
*Smith, C.M., David, M.B., Mitchell, C.A., Masters, M.D., Anderson-Teixeira, K.J., Bernacchi, C.J. & DeLucia, E.H. (2013) Reduced Nitrogen Losses after Conversion of Row Crop Agriculture to Perennial Biofuel Crops. *Journal of Environmental Quality*, **42**, 219-228.

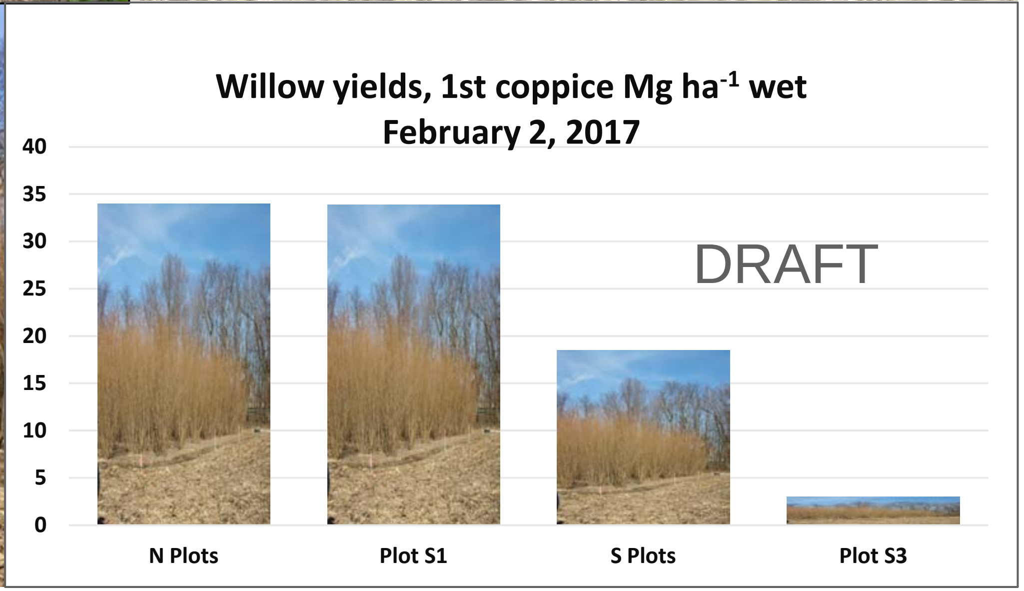
2- Technical Approach - Benchmarks

- **Against previously reported results**
  - Field data in 2015-2016 provide several statistically significant differences in environmental indicators, reflecting the more measurable impact of willows as they reach mature size
- **Against technical targets**
  - Target: Achieve 30% N-NO_3 reductions based on current knowledge (Smith et al., 2013)
    - We have met and exceeded our technical target of decreasing nitrate concentrations in soil water in 2015.
- **Important changes/achievements since 2015**
  - Focus on more ecosystem services
  - Developed techno-economic analysis of production and logistics at watershed scale
  - International exposure GBEP and EUBCE
  - BT16 Vol. 2 Case Study
  - Hypoxia Workshop
  - Working to understand and connect with potential nutrient markets to provide viable solution to nutrient loss reduction strategy.

3 - Technical Accomplishments/ Progress/Results

Field trial: First Coppice cycle, Spring 2013 to Winter 2017





3- Field monitoring infrastructure

Buried Nitrate collectors

Soil-water sample collectors

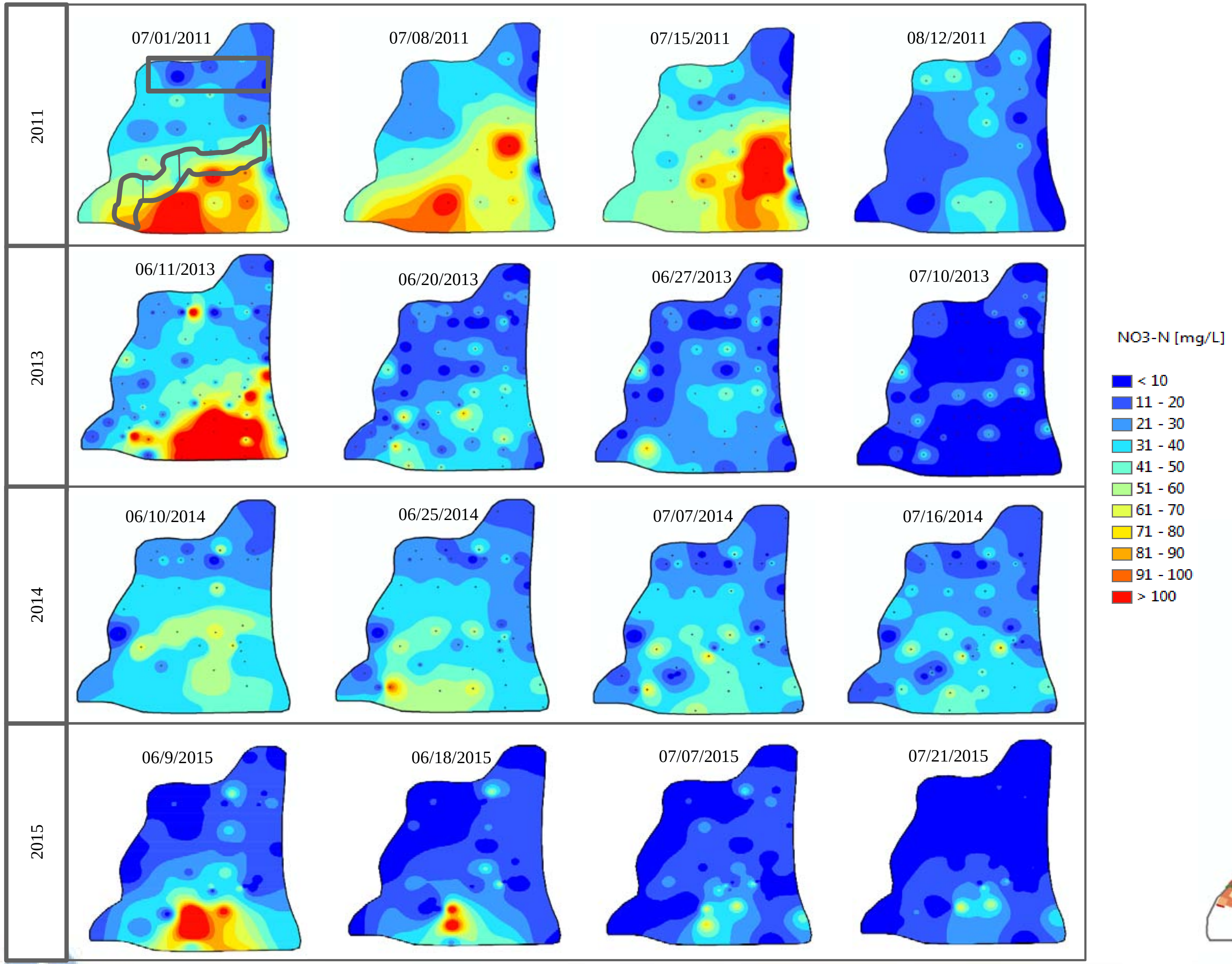
Water table monitoring

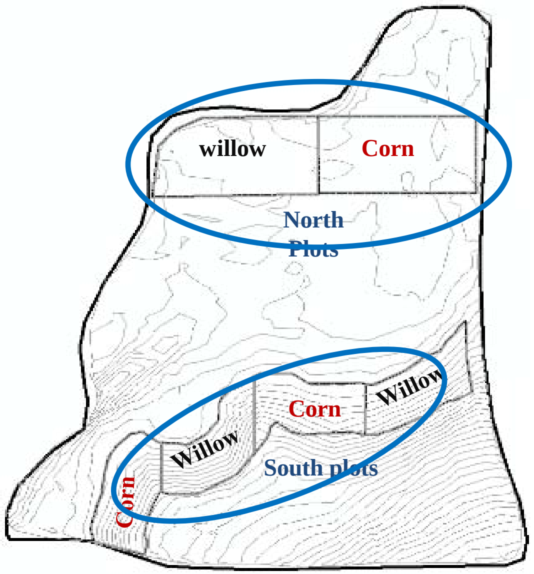
Static GHG chambers

Profile soil moisture monitoring
[10, 30, 60, 100, 120 cm depth]

Crop growth monitoring

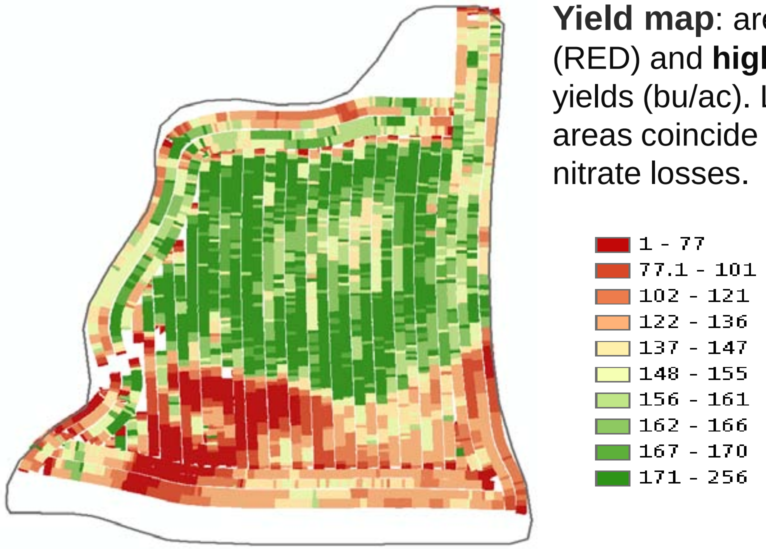
3- Technical accomplishments – Changes in nitrate concentrations – 5 ft bgs





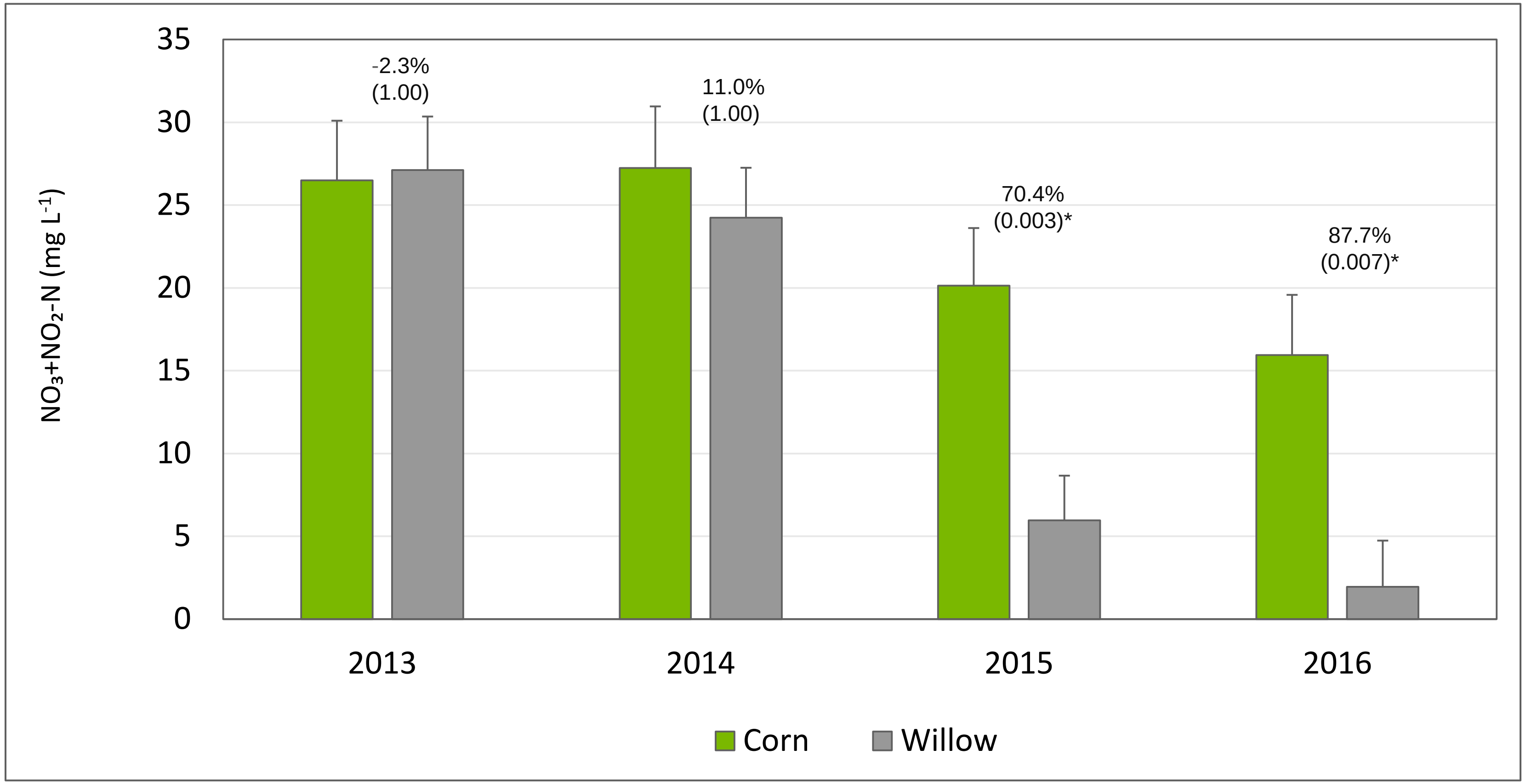
Fertile floodplain soil

Marginal leaching soil



Yield map: areas of **low** (RED) and **high** (GREEN) yields (bu/ac). Low yield areas coincide with high nitrate losses.

3- Technical accomplishments- NO_3-N leachate analysis at 5 ft bgs

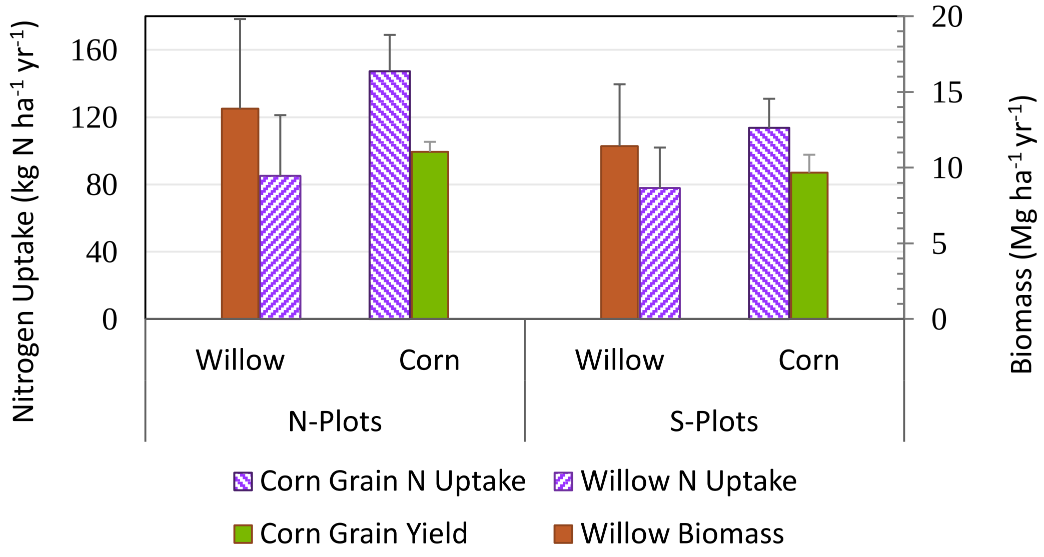


2013-2015 Mean NO_3+NO_2-N concentrations in soil water under different crop covers and soil conditions. Asterisk indicates statistically significant difference between crop covers.

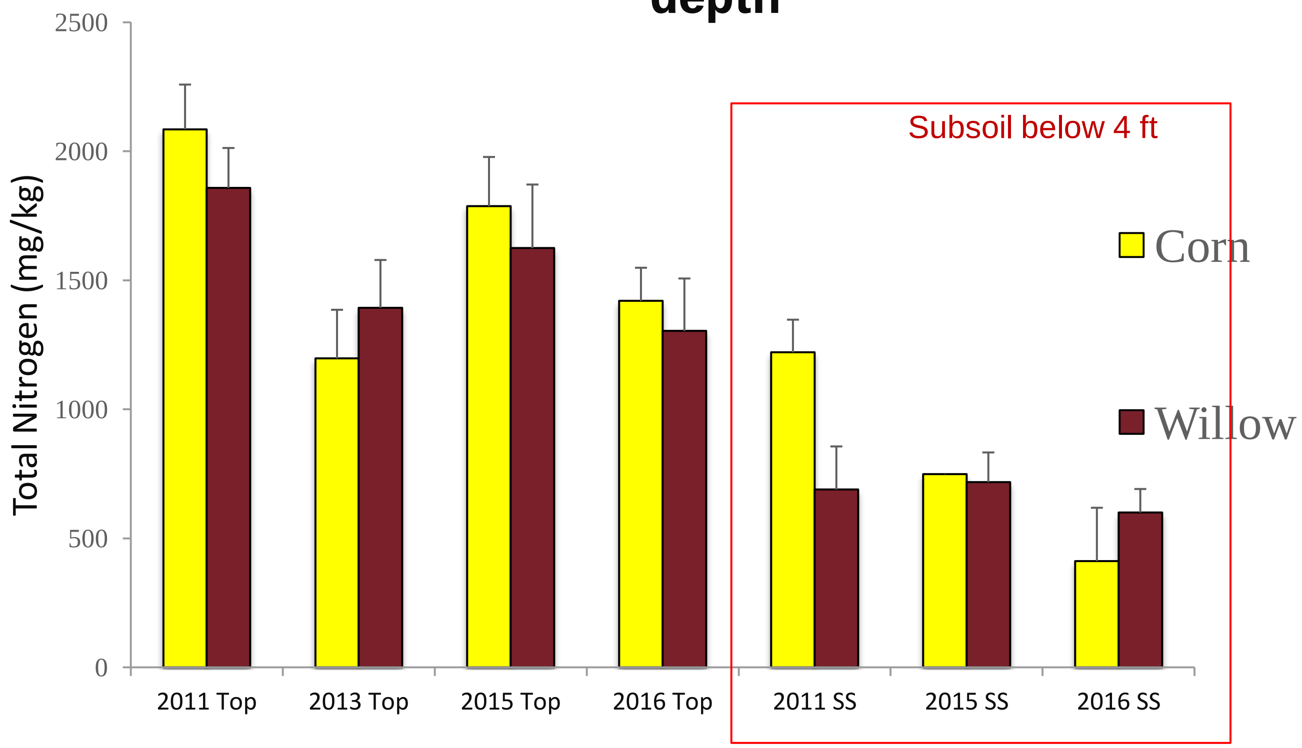
The Goal to reduce nitrate leached by 30% compared to BAU was met in 2015.

3- Technical Accomplishments - Nitrogen in crops and soil

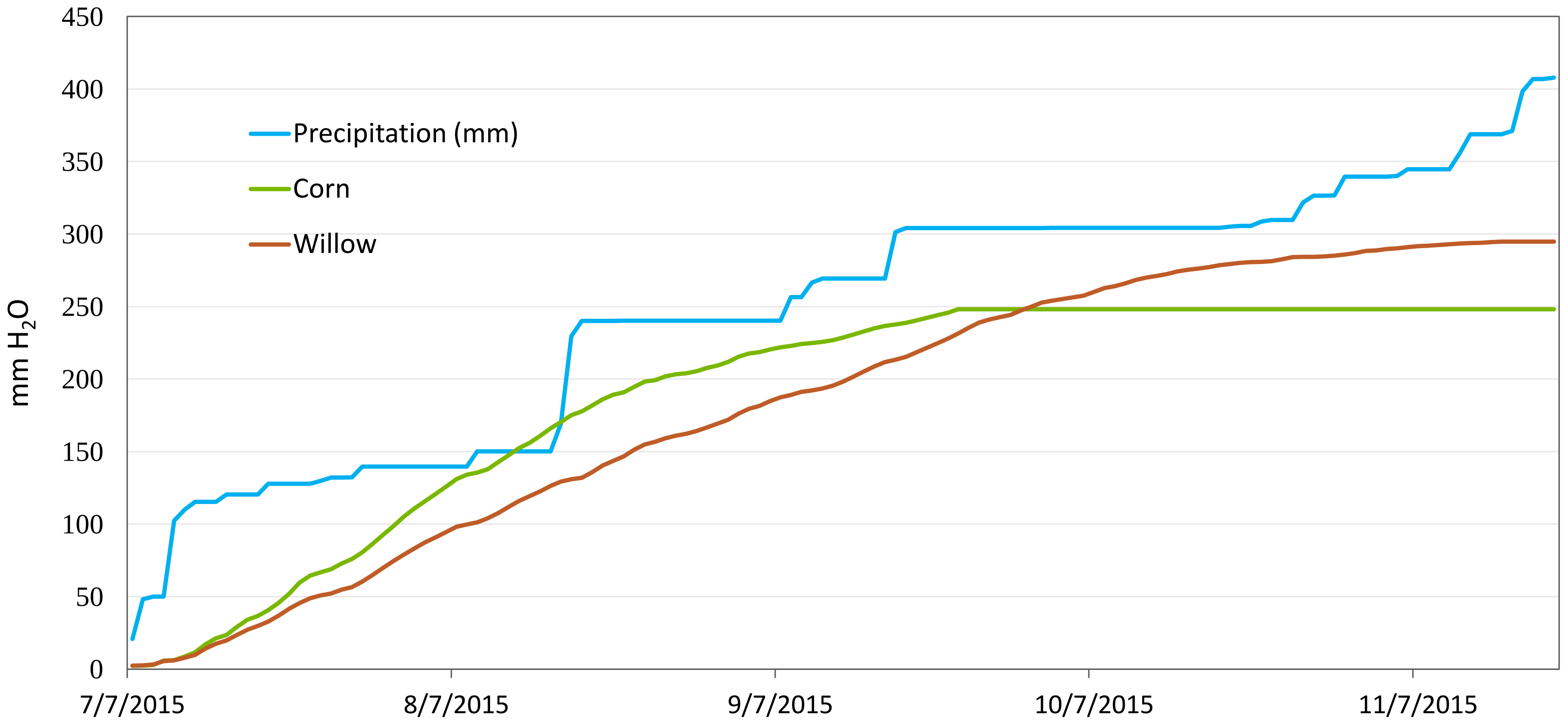
Nitrogen stored in crop tissue



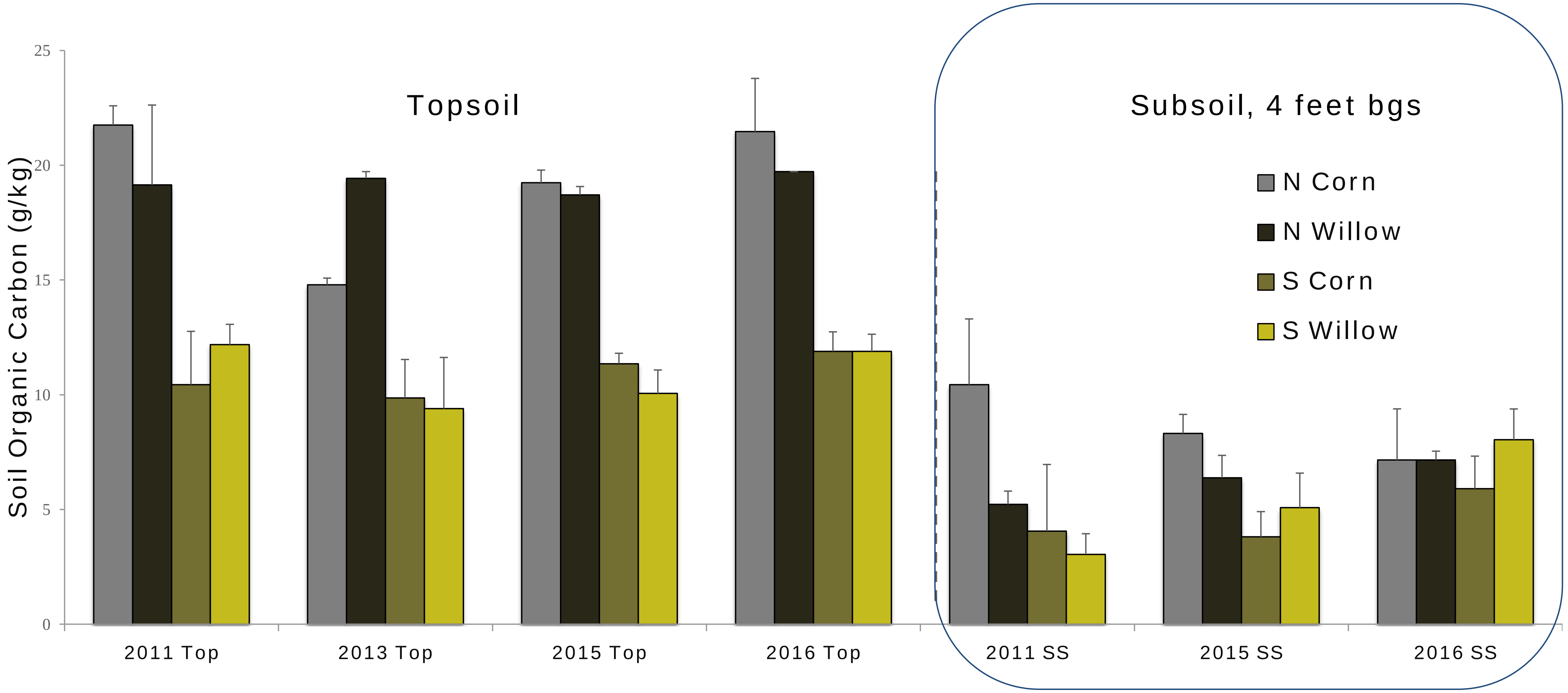
Total Soil Nitrogen in soil by vegetation type and depth



3- Technical Accomplishments - Cumulative water use (transpiration)



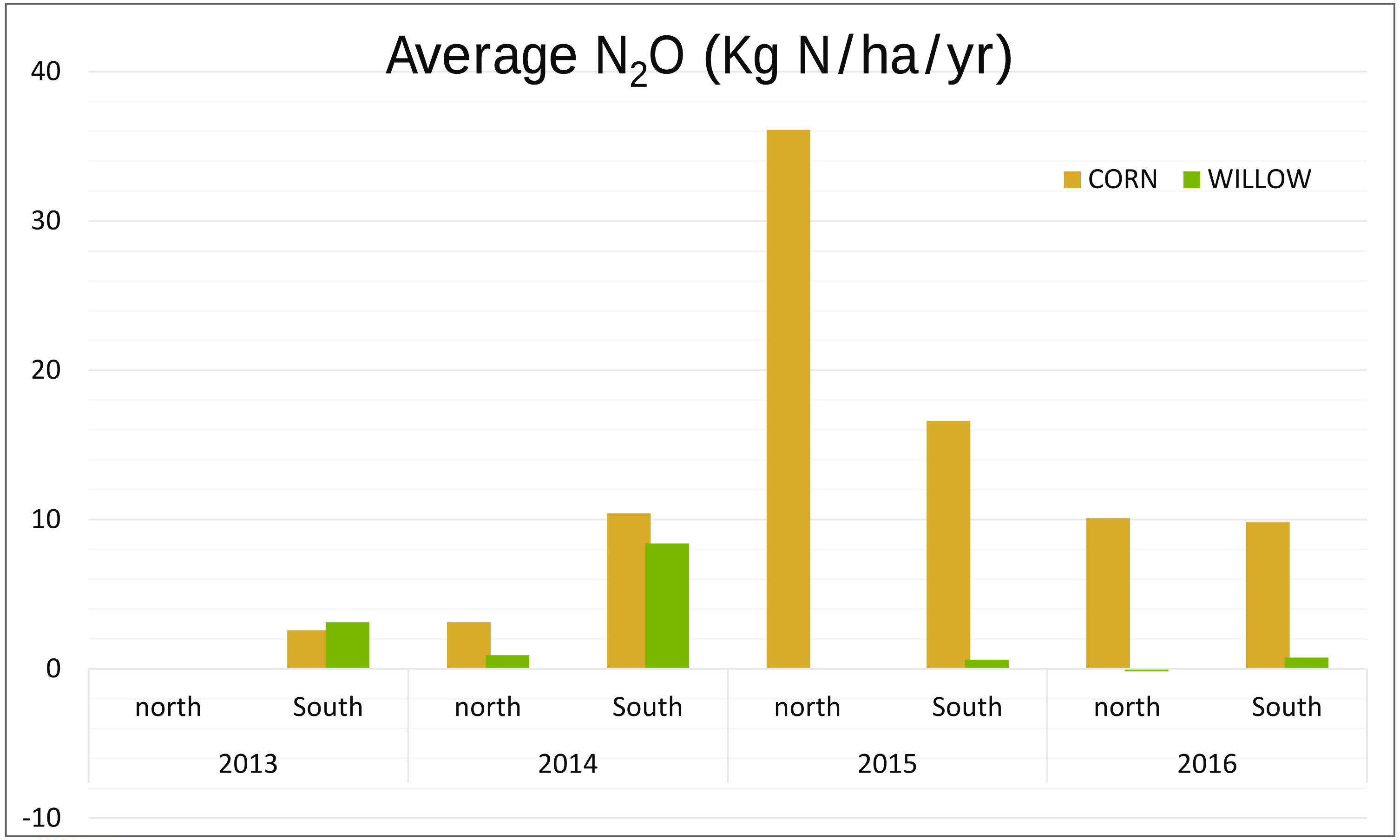
3- Technical Accomplishments -2011-2016 Soil Organic Carbon (SOC)



Soil organic carbon (SOC) means and standard error.
Topsoil samples collected from the top 6 inches of a 4-foot core, subsoil samples from the bottom 6 inches of a 4-foot core.

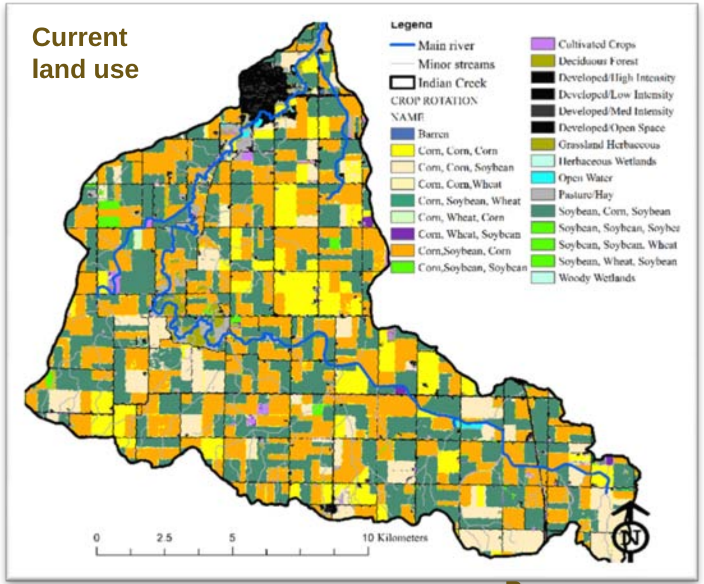
3- Technical Accomplishments - GHG soil fluxes

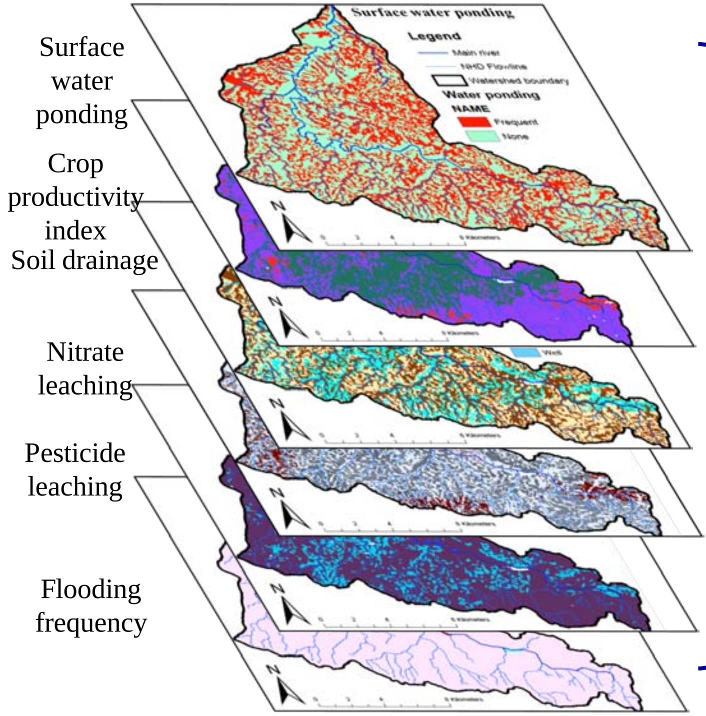
- In-field emissions (shown) - *Flux from soil (FY13-19)*
- Lifecycle GHG emissions - *Reduced need for fertilizer synthesis, transport, application etc., added transport -in LCA effort (FY17)*



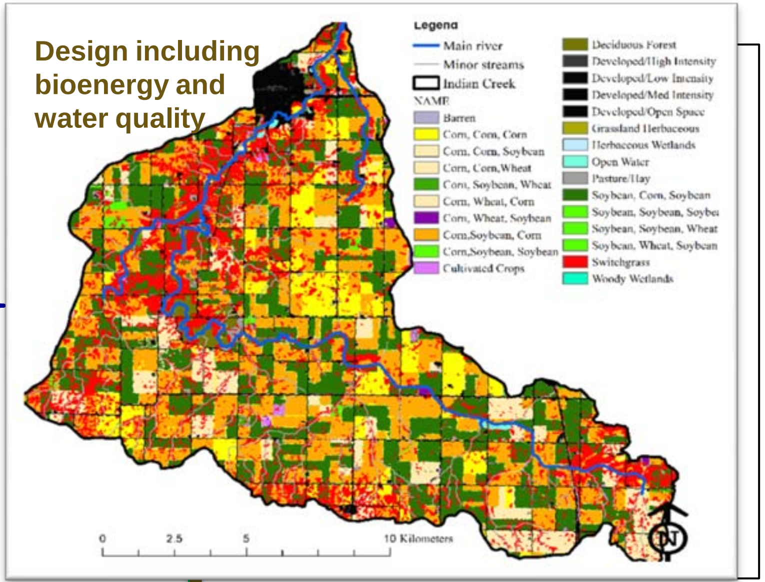
3- Technical accomplishments- Watershed design for ecosystem services on "marginal lands"

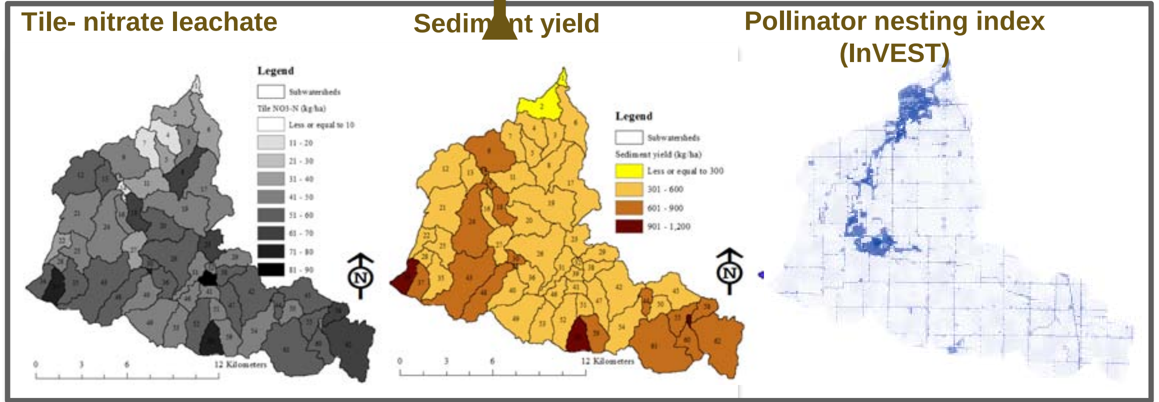
Current land use

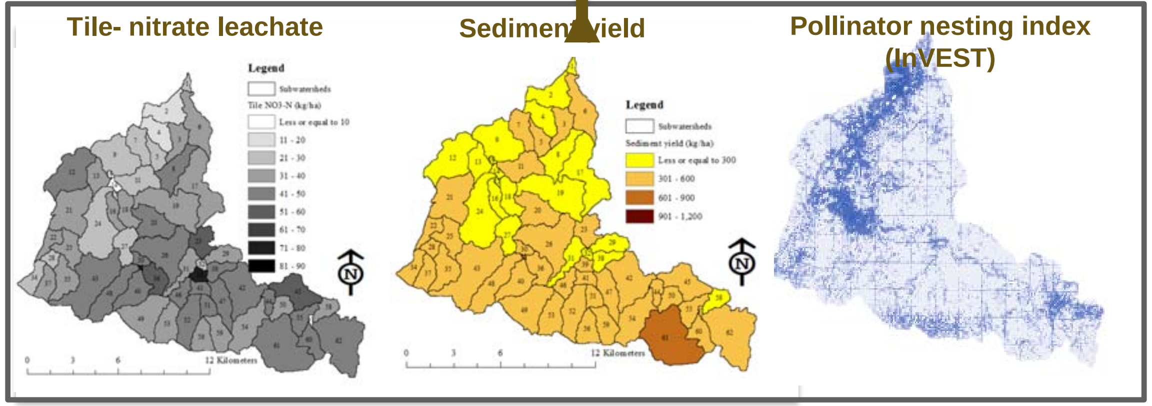




Design including bioenergy and water quality







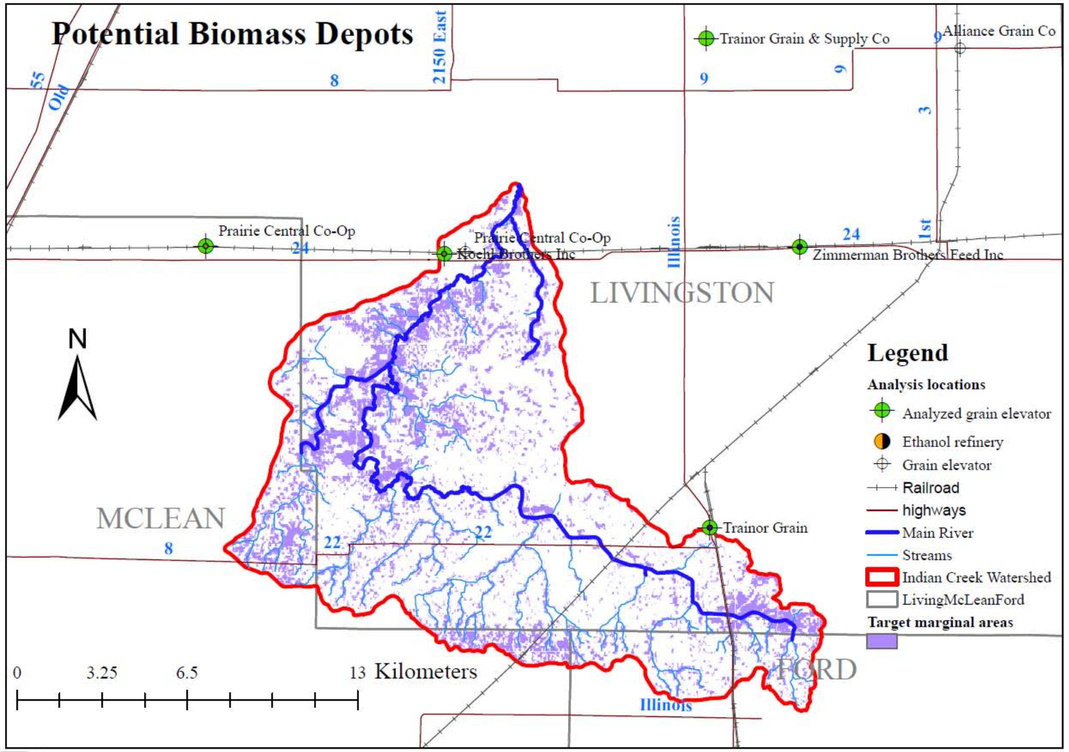
Ssegane et al., 2016

3- Technical accomplishments - Biomass logistic system analysis

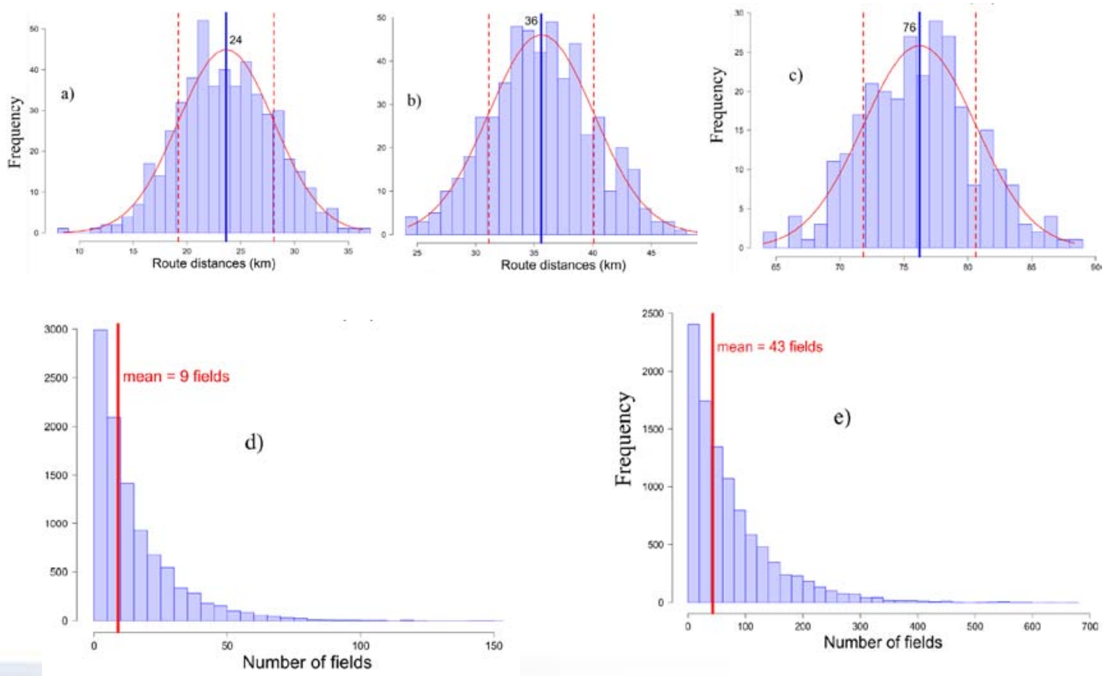
In collaboration with INL and SUNY

Modeled production and transport to depot (EcoWillow). Subsequent steps (BLM) unvaried between BAU and LD.

- Modeled at biomass price $71/dry ton (range of $23-46/wet ton)
- Willow planted either in:
  - any field as the main crop (BAU) or
  - in buffers at targeted subfield hotspots (LD) in underproductive or vulnerable land (flooding, ponding, leaching nitrate etc.) (purple shade)

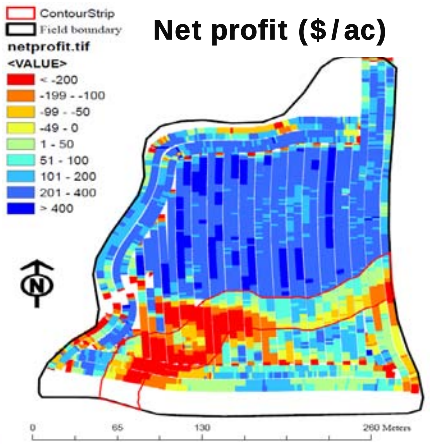


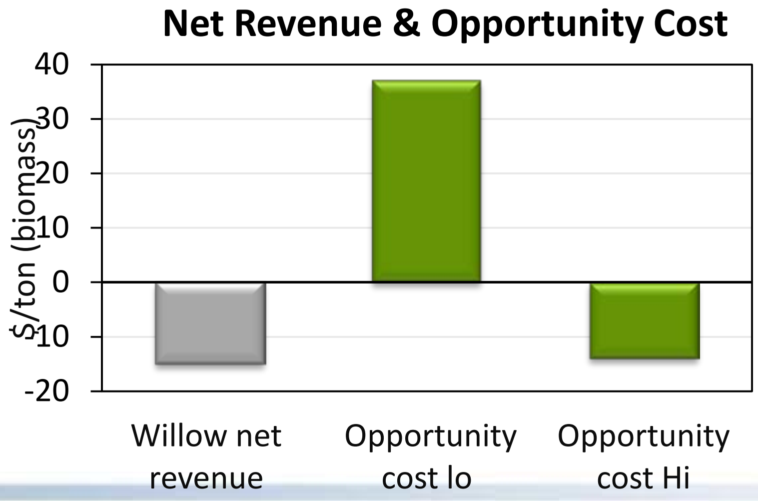
Calculating distances and number of fields



3- Technical Accomplishment - Economics

- Willow does not provide a positive net revenue in Indian Creek Watershed
- Land rental cost is major reason
- Reduced losses ~$5/ton are seen in the LSSF (saving on fertilizer and headland)
- LMSF present higher losses, depending on distance
- Nitrogen recovery savings allow for an extra ~5 to 7 km of inter-field distance.
- Opportunity cost (difference in net revenue between willow and corn in that area: choosing to grow willow over corn) suggest willow may still be competitive compared to low yielding corn (3.2 Mg ha^{-1}).





Case	Scenario	Transport distance km	Annual net revenue ($/ha)	Annual net revenue ($/wet metric ton)	Opportunity cost: min yield [max yield] ($/ton) [b]
1 (2.0 ha)	BAU	Min 2	-$145.79	-$10.34	41.59 [-9.66]
		Max 18	-$177.92	-$11.87	40.06 [-11.19]
	Landscape: single subfield (LSSF)	Min 2	-$108.73	**-$5.22**	46.71 [-4.54]
		Max 18	-$135.91	**-$6.55**	45.38 [-5.87]
	Landscape: Multiple (4) subfields (LMSF)	Most likely 24	-$217.45	-$10.48	41.45 [-9.80]
2 (10.1 ha)	BAU	Min 2	-$108.73	-$8.55	43.38 [-7.87]
		Max 18	-$143.32	-$10.21	41.72 [-9.53]
	Landscape: single subfield (LSSF)	Min 2	-$81.54	**-$3.97**	47.96 [-3.29]
		Max 18	-$116.14	**-$5.61**	46.32 [-4.93]
	Landscape: Multiple (9) subfields (LMSF)	Most likely 36	-$237.22	-$11.38	40.55 [-10.70]
3 (40.5 ha)	BAU	Min 3.5	-$91.43	-$7.76	44.17 [-7.08]
		Max 16.4	-$118.61	-$9.08	42.85 [-8.40]
	Landscape: single subfield (LSSF)	Min 3.5	-$66.72	**-$3.21**	48.72 [-2.53]
		Max 16.4	-$93.90	**-$4.54**	47.39 [-3.86]
	Landscape: multiple (43) subfields (LMSF)	Most likely 76	-$303.94	-$14.58	37.35 [-13.90]

3- Technical accomplishments - Lifecycle cost distribution

Life Cycle Costs	Case 1					Case 2					Case 3				
	BAU		Landscape: single subfield		Landscape: multiple subfield	BAU		Landscape: single subfield		Landscape: multiple subfield	BAU		Landscape: single subfield		Landscape: multiple subfield
	Min (%)	Max (%)	Min (%)	Max (%)	Most Likely (%)	Min (%)	Max (%)	Min (%)	Max (%)	Most Likely (%)	Min (%)	Max (%)	Min (%)	Max (%)	Most Likely (%)
Land Costs	55	54	57	56	52	57	55	59	57	51	58	56	59	58	48
Admin.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Establishment	11	10	11	10	10	10	10	10	10	9	10	10	10	10	9
Fertilizer	2	2	0	0	0	2	2	0	0	0	2	2	0	0	0
Harvest	21	20	21	21	25	21	20	21	21	25	19	19	20	19	22
Transport	6	9	6	8	8	4	7	5	8	10	5	7	5	7	16
Stock Removal	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Total	**100%**														

3- Technical accomplishments- Depot to reactor throat - BLM results

(With INL)

From EcoWillow ~$17 ~$5

Excluded from EcoWillow $67.8

	Stover [a]	Switchgrass [b]	Willow [b]	Stover on marginal
Harvest and Collection ($/DMT)	$20.05	$20.56	$14.61	$32.00
Transport to Depot ($/DMT)	$6.27 [c]	$6.27 [c]	$2.09 [d]	$6.27 [c]
Storage ($/DMT)	$19.76	$19.83	$10.37	$19.76
Loading ($/DMT)	$5.42	$7.12	$0.00	$5.42
Depot Preprocessing ($/DMT)	$41.46	$41.46	$54.07	$41.46
Handling ($/DMT)	$1.48	$1.48	$3.40	$1.48
Total logistics ($/DMT)	$94.44	$96.72	$84.54	$106.39

BLM logistics per dry metric ton based on a minimum draw radius of 0.3 km in the Indian Creek Watershed, IL. The 0.3 km haul distance is the minimum Euclidean distance between the proposed depot location at Trainor Grain in Strawn, IL (Figure 1) and a marginal subfield.

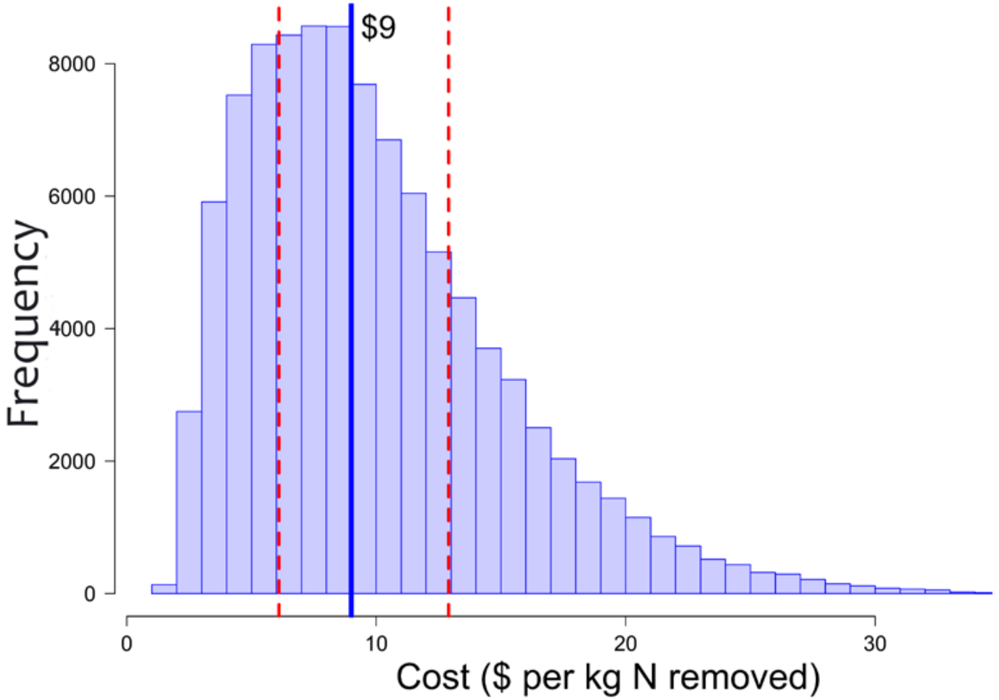
[a] Corn scenario refers to logistics of collecting corn stover grown on non-marginal areas
[b] Switchgrass and willow scenarios refer to logistics of growing either crop on marginal areas
[c] The corresponding value for the maximum draw radius of 18 km is $6.97
[d] The corresponding value for the maximum draw radius of 18 km is $3.93

3- Technical accomplishments - Cost of water quality service

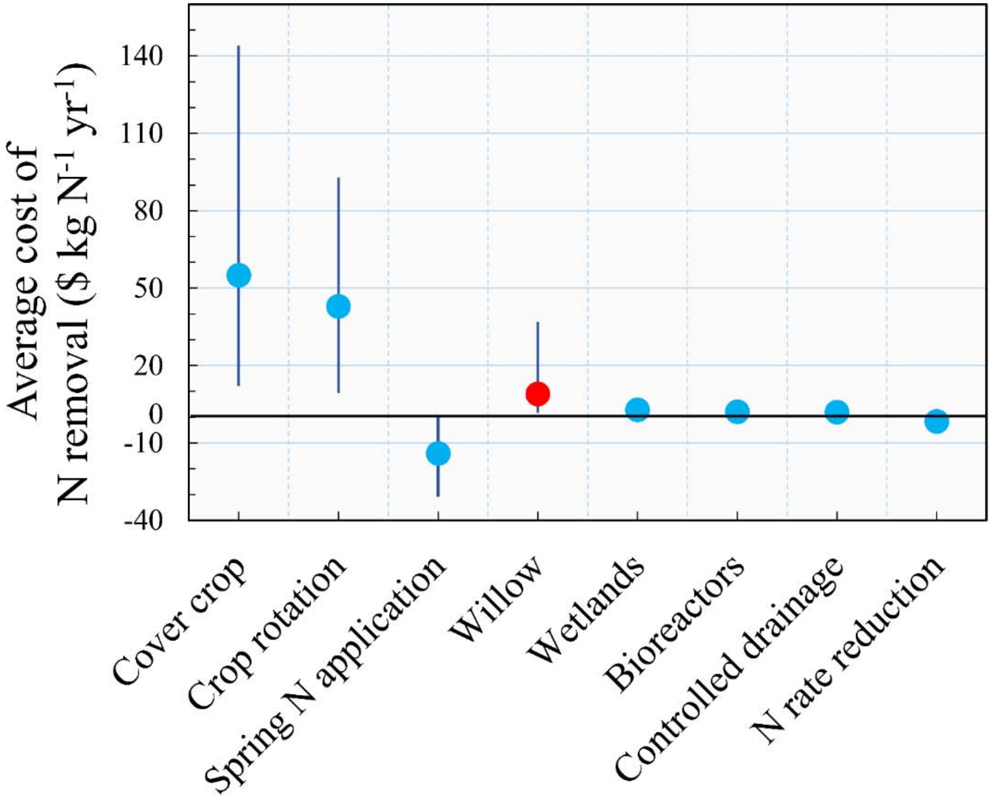
Costs vary based on:

- N removal % : 40-80% [literature]
- Nitrate leachate: 20-50 kg N/ ha [literature]
- Net revenue [Ecowillow]
  - Assumes for now local distributed biomass use (no biorefinery)

Cost N removed = Revenue/leachate loading * reduction %



***Farmer's perspective**: When considering environmental services, normalized costs show that a dual crop landscape could be competitive with other conservation practices.*

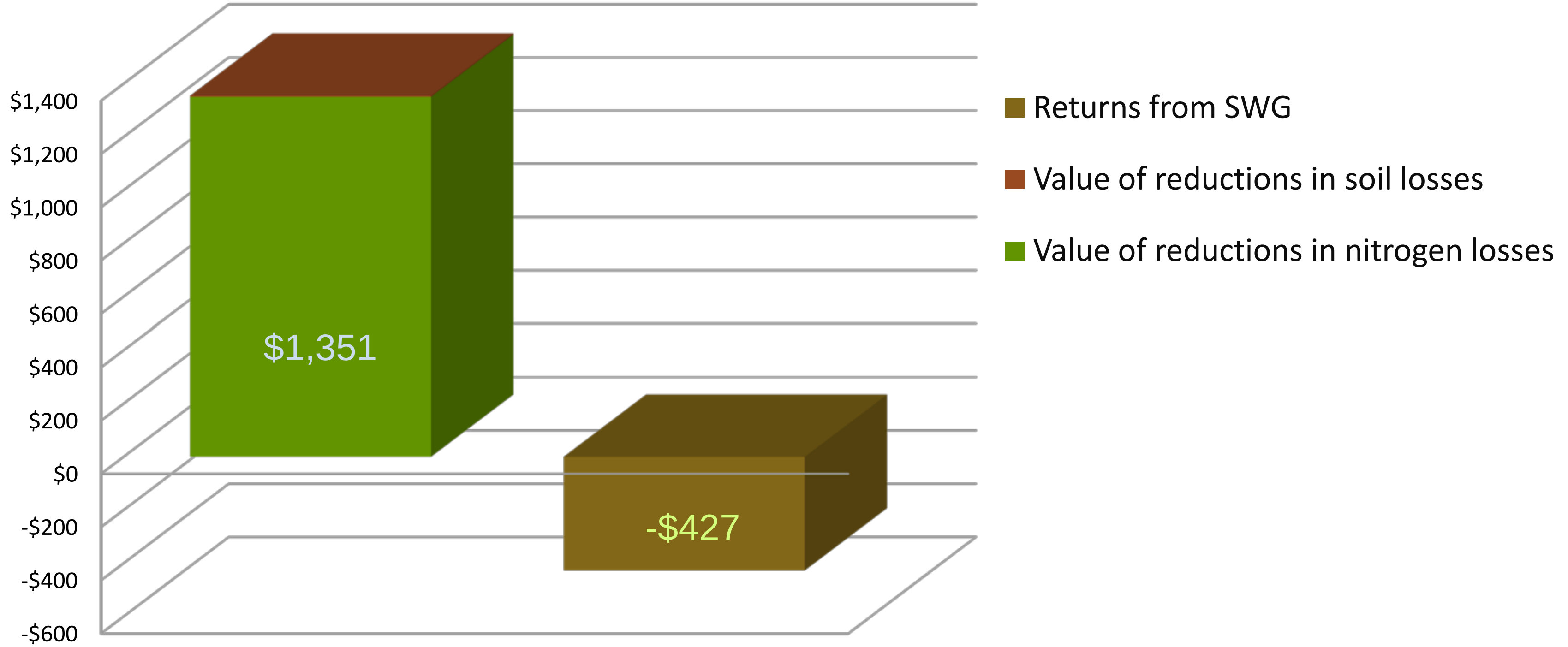


Christianson L, Tyndall J, Helmers M. Financial comparison of seven nitrate reduction strategies for Midwestern agricultural drainage. Water Resources and Economics. 2013;2–3:30-56

3- Technical accomplishments - Ecosystem Services Value

Societal perspective: What would it cost to society to pay for the additional regulating services provided?

Value of ES from reductions in nitrogen and soil losses $/ha



Per hectare, losses from switchgrass production could be more than compensated by the value of the Ecosystem Service provided. Data on willows in process.

3-Technical accomplishments - Stakeholder engagement in the watershed, regionally, and nationally

- Multiple engagements in previous review period (FY13-15)
- Bioenergy workshop, Springfield IL, November 30, 2016 with UIUC Extension, invited to replicate in other watersheds March 15, 2017.
- Presented to Illinois Agricultural Leaders Foundation
- Planned field day for Chicago Farmers Summer 2017 tour
- Membership in Vermilion River Watershed Steering Committee for nutrient conservation initiative
- Environmental Utility Working Group, Illinois, developing a nutrient exchange system to meet hypoxia Task Force and IL Strategy's nutrient loss reductions (2015-16)
- "Bioenergy Solutions to Gulf Hypoxia" Workshop, August 2016. Convened *national stakeholders*.
- Case study incorporated in BT16 Vol. 2 and GBEP-IEA report

4 - Relevance

Barriers addressed

Feedstocks
- **Ft-B**: Production

Sustainability
- **St-E**: Best Practices for Sustainable Bioenergy Production
- **St-F**: System approach to Bioenergy Sustainability
- **St-G**: Land Use and Innovative Landscape Design

Project is relevant to:

- DOE and BETO: through WBS element "Sustainable System Design" provides field data and designs for sustainable bioenergy landscapes. Addresses a critical "how" question at the base of sustainability analysis and land use change, provides example and data for models, how do ideas turn to practice?
  - Contributes to fulfilling BETO goal of, by 2018, validating landscape design approaches.
- Conversion industry: tests ways to intensify biomass supply and prepares community for investments in bioenergy.
- Rural communities: Provides producers with a value proposition. Considers needs and barriers within farming community and gives stakeholders an opportunity to be part of the design process and options to diversify their production..
- Through developing partnerships, the project provides a substantial opportunity to link suppliers and end users of biomass for integrated deployment at the landscape scale.
- State: provides best practices and an avenue to cost-effectively meet Nutrient Loss Reduction strategies requested by Hypoxia Task Force.
- Society: provides concepts and data to develop alternative land management systems to deliver food, feed, energy and ecosystem services.
- Scientific community – provide primary data for models, methods and procedures for common research and meta-analyses.

5 - Future Work

- **Continue field monitoring and harvest second coppice in Winter 2019**
  - Develop and implement biodiversity monitoring protocol (FY17-19)
  - Understand yield changes and water quality through second cycle (FY17-19)
- **Complete second landscape design** to improve on the first, focus on drainage structures, improved production and nutrient removal. (FY17-18)
- **Quantify watershed scale ES (GHG emissions and Soil Organic C)** under different designs (FY17)
- **Continue to develop economic framework and analysis** (FY17-19)
  - Understand potential markets for ES
  - Complete evaluation of ES value, develop a calculator tool for ES
- **Conduct LCA** of designs developed
- **Develop pathway** to include bioenergy landscapes in conservation BMPs
- **Assemble all elements into a streamlined framework** for planning and analysis at larger scale, develop network of observatories (FY18-19).

Acknowledgements

- US DOE-BETO, Kristen Johnson, Alicia Lindauer, Alison Goss Eng
- Terry Bachtold, SWCD, Eric McTaggart, NRCS, Livingston County, IL
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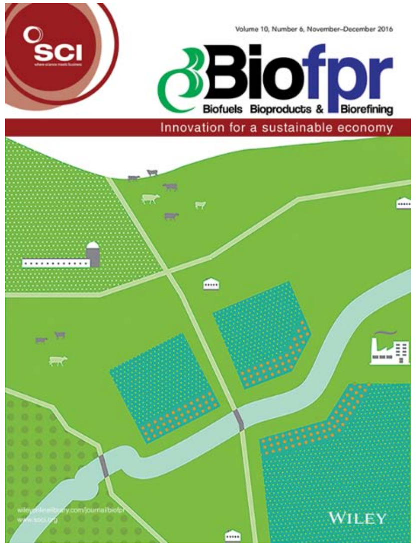
- Many summer undergraduate interns
- Our collaborators at SUNY-ESF, U. Michigan, SIU, UIUC, INL, ORNL,
- Chip Energy
- The Argonne team: Colleen Zumpf, Herbert Ssegane, Patty Campbell, Jules Cacho

Summary

Overview and approach

Project **develops Landscape Design concepts** to address LUC and environmental concerns.

- Field testing to watershed scale-up
- Engage stakeholders and provide visibility at farmer to National scale
- Develop watershed designs for water quality and other ecosystem services



Accomplishments

- Providing **yield, environmental data** that are showing a positive and significant buffer impact
- Developed an **approach to identify vulnerable or underproductive land** at the small watershed scale, modeled potential environmental services and productivity of its use for bioenergy
- Created a **communication channel** with landowners and producers to elicit input for farmer-vetted designs
- Provided input to a broad **partnership to develop a nutrient exchange mechanism** that uses bioenergy crops to contribute to nutrient loss reduction strategies to meet Gulf Hypoxia targets.
- Completed a **techno-economic analysis** of production and logistics comparing BAU with landscape design.
- Developed procedure to monitor biodiversity at the field scale.

Relevance

- Relevant to **BETO**'s WBS element "Sustainable system design"
- Supports **conversion industry** by providing additional revenue streams
- Addresses **Barriers in sustainability and sustainable feedstock supply** including farmers concerns.
- **Helps local governments** find solutions to minimize nutrient losses and meet Hypoxia Task Force goals
- Provides **farmers** with value proposition for adopting bioenergy

Future Work

- Continue field trial for second coppice cycle
- Complete improved Landscape Design
- Continue to develop economic framework and analysis
- Quantify other ES at watershed scale
- Conduct LCA
- Develop pathway to include bioenergy landscapes in conservation BMPs.

Additional Slides

Responses to Previous Reviewers' Comments

- **Logistics and economics were not considered**
  - Response:
    - Lack of data prevented us from carrying out this analysis in the past.
    - We have now conducted an economic analysis of the differences between business as usual and landscape-based logistics in the model watershed.

- **Uncertainty on how the findings/approach can be scaled up**
  - Response:
    - Field data: We are working towards building a network of sites with common methodologies so that we can provide quality data for models and meta-analyses.
    - Modeling: We are providing "building blocks", methodological approaches on the characterization of target soils and landscapes, modeling alternative landscapes, determining the economics, and valuing the Ecosystem services. In FY17-19 we will expand our work to include lifecycle analysis and we will assemble all these building blocks into a scalable platform to extend the analysis to larger areas.

Select Publications, Patents, Presentations, Awards, and Commercialization

1. Zumpf C., H. Ssegane, P. Campbell, M.C. Negri, and J. Cacho (2017) **Nitrogen recovery and biomass production: environmental ecosystem services at the field scale**. Submitted to J. Environmental Quality.
2. Cacho, J. and M.C. Negri (2017) **Integrating perennial bioenergy crops into agricultural landscapes to address water quality issues.** Invited, WIREs (in preparation).
3. Jager, H., K. Johnson, S. Nair, C. Negri, L. Ovard, J. Ralbowski and C. Villacil 92017) **Bioenergy solutions to Gulf Hypoxia workshop: Summary Report**. Draft in preparation.
4. Efroymson,R., M. Langholtz, K. Johnson. C. Negri, A. Turhollow, K. Kline, I. Bonner,and V. Dale (2017) **Synthesys, interpretation, and Strategies to enhance environmental outcomes**. In: 2016 Billion Ton Report, Volume 2, Chapter 14. January 2017, U.S. Department of Energy.
5. H. Ssegane, C. Zumpf, M. C. Negri, P. Campbell, J. Heavey, and T.A. Volk (2016) -**The Economics of Growing Shrub Willow as a Bioenergy Buffer on Agricultural Fields. A case study in the Midwest Corn Belt**. Biofuels, Bioproducts and Biorefining. DOI: 10:1002/bbb.1679.
6. Negri, M. C. and H. Ssegane (2016) **Bioenergy crops: delivering more than energy.** In "Commercializing Biobased Products". S. Snyder Editor, Royal Society of Chemistry, Cambridge, UK.
7. Graham, J.B., J.I. Nassauer, M. C. Negri and H. Ssegane (2016) **Landscape boundary objects in socioecological research: engaging stakeholders to investigate production alternatives for perennial Energy crops**. Ecology and Society. In review.
8. Graham, J. B., J. I. Nassauer, W. Currie, H. Ssegane and M.C. Negri (2016) **Assessing wild bee abundance in perennial bioenergy landscapes: Effects of bioenergy crop composition, landscape configuration, and bioenergy crop area.** Landscape Ecology .In review
9. Ssegane H. and M C. Negri (2016) **An Integrated Landscape designed for Commodity and Bioenergy Crops in a Tile-drained Agricultural Watershed.** Journal of Environmental Quality, published May 31, 2016, DOI:10.2134/jeq2015.10.0518.
10. Hamada, Y., H. Ssegane, and M. C. Negri (2015) **Mapping Intra-Field Yield Variation Using High Resolution Satellite Imagery to Integrate Bioenergy and Environmental Stewardship in an Agricultural Watershed.** Remote Sensing, 2015, 7, 9753-9768; doi:10.3390/rs70809753.
11. M. C. Negri and H. Ssegane (2015) **Lignocellulosic plants as buffer zones in the U.S**. In "Mobilizing sustainable Bioenergy supply chains. Inter-task Project synthesis report" IEA Bioenergy ExCo:2015:04
12. Ssegane, H., M.C. Negri, J. Quinn, M. Urgun Demirtas (2015) **Field scale Design of multifunctional landscapes for food, bioenergy and ecosystem services**. Biomass and Bioenergy 80, 179-190.
13. Murphy, J. T., Macal, C., Ozik, J, and Negri, M. C.. **"Modelling Farmer Bioenergy Crop Adoption: Current Strategies and New Ways Forward"**. To be submitted to *Environmental Modelling and Software.*
14. Negri M.C., Ssegane H and P . Campbell. 2015. Diversified landscapes provide sustainable opportunities for growing food, feed, fiber and energy. Chicago Farmers Farmland Forum., Joliet, IL February 7, 2015
15. ANL (2014) *Incorporating Bioenergy into Sustainable Landscape Designs—Workshop Two: Agricultural Landscapes; A Draft Report*. Argonne National Laboratory, https://bioenergykdf.net/content/incorporating-bioenergy-sustainable-landscape-designs%E2%80%94workshop-two-agricultural-landscapes