INTEGRATED STRATEGIES TO REDUCE NUTRIENT LOSS AND REGENERATE SOILS IN ILLINOIS

DECEMBER 2017

Part 1: Market Drivers Overview
Part 2: Policy Briefs
Part 3: Soil Carbon Strategy

This report was produced with generous support from the Walton Family Foundation.

delta institute

EXECUTIVE SUMMARY

Nutrient losses and soil degradation are symptomatic of the current state of agricultural systems that define much of the Illinois landscape. Excessive nutrients in waterways are currently the leading cause of water quality impairments in the Midwest and across the globe. Furthermore, the loss of soil and its carbon-rich organic matter is detrimental to crop cultivation, water quality and infiltration, nutrient cycling, pest moderation, as well as the release of carbon dioxide into the atmosphere. Though federal and state agencies have developed strategies to combat these issues, it is apparent that their success will require extensive new collaborations, innovation in tools and approaches, and significant financial resources. The findings and recommendations are broken into a three-part series of documents, described below:

The first part outlines markets drivers that could provide mechanisms to advance the plans proposed in the Illinois Nutrient Loss Reduction Strategy (NLRS), in addition to various policy and social drivers that could be leveraged in Illinois. These range from initiatives that are already in place to ideas that build on existing programs to new approaches that have not yet been implemented at a large scale or in the agricultural sector. These include low-cost financing through the state revolving fund, pay-for-performance incentive programs, supply chain initiatives, emerging mechanisms for investors, and risk mitigation.

The second part focuses on the role of Illinois state agencies in advancing the NLRS and highlights the opportunities to leverage resources that support its implementation. The three areas of attention include: realigning the state revolving fund program, piloting a pay-for-performance conservation approach, and incentivizing long-term conservation by providing for land tenure security.

The third part identifies opportunities for broader programmatic alignment between the NLRS and soil health to move toward a recarbonized rural landscape that provides water quality, climate and community benefits. This section also provides a snapshot of available models and tools highlighting the gaps and opportunities in utilizing those tools to support successful development and adoption of market drivers, reducing pollution, and strengthening the sustainability of agricultural systems in Illinois.

About Delta Institute

Established in 1998, Delta Institute is a Chicago-based nonprofit organization that collaborates with communities to solve complex environmental challenges across the Midwest. Delta Institute works to achieve landscape-level impacts through its agriculture and water quality programs by working in partnership with farmers, agricultural retailers, local and national nonprofits, conservation districts, and state and federal partners.

Visit online at www.delta-institute.org.

delta institute

Photo credit: John Wepking

MARKET DRIVERS FOR THE ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY

OCTOBER 2017

Part 1 of 3: Market Drivers Overview

This whitepaper provides an overview of various potential market drivers that could be leveraged in Illinois to advance the implementation of the Illinois Nutrient Loss Reduction Strategy (NLRS). These range from existing initiatives to new approaches that have not yet been implemented at a large scale or in the agricultural sector.

This document is one part of a series of three documents created by Delta Institute to illuminate opportunities for various stakeholders to support NLRS implementation.

delta institute

Contributors

Olga Lyandres, Sr. Program Specialist
Ryan Smith, Program Lead
David LeZaks, Program Lead
Ryan Anderson, Program Lead
Amy Yanow, Communications Associate
Katie Yocum Musisi, Director of Communications and Development

About Delta Institute

Established in 1998, Delta Institute is a Chicago-based nonprofit organization that collaborates with communities to solve complex environmental challenges across the Midwest. Delta Institute works to achieve landscape-level impacts through its agriculture and water quality programs by working in partnership with farmers, agricultural retailers, local and national nonprofits, conservation districts, and state and federal partners.
Visit online at www.delta-institute.org.

Acknowledgements

This was produced with generous support from the Walton Family Foundation.

TABLE OF CONTENTS

ACPF – Agricultural Conservation Planning Framework
AFT – American Farmland Trust
AOI – Area of Interest
ARS – Agricultural Research Service
BMP – Best Management Practice
BOD – Biological Oxygen Demand
CC – Corn/Corn Rotation
CCS – Conservation Cropping System
CS – Corn/Soybean Rotation
CEAP – Conservation Effects Assessment Project
CWA – Clean Water Act
GHG – Greenhouse Gas
GIS – Geographic Information System
GMO – Genetically Modified Organism
HUC – Hydrologic Unit Code
LiDAR – Light Detection and Ranging
MAEAP - Michigan Agriculture Environmental Assurance Program
MLRA – Major Land Resource Area
MRCC – Midwest Row Crop Collaborative
MRTN – Maximum Return To Nitrogen
MWRD – Metropolitan Water Reclamation District of Greater Chicago
NASS – National Agricultural Statistics Service
NGO – Non Governmental Organization
NLRS – Nutrient Loss Reduction Strategy
NPS – Non Point Source
NRCS – Natural Resources Conservation Service
NTT – Nutrient Tracking Tool
POTW - Publicly Owned Treatment Works
PWSLP – Public Water Supply Loan Program
RMA – Risk Management Agency
SASB – Sustainability Accounting Standards Board
SEC – Securities and Exchange Commission
SRF – State Revolving Fund
STEPL – Spreadsheet Tool for Estimating Pollutant Load
T- Soil Loss Tolerance
US EPA – United States Environmental Protection Agency

INTRODUCTION

Water quality issues associated with excessive nutrient loads are globally pervasive. In the U.S., Gulf of Mexico eutrophication and hypoxia have received considerable attention from regulatory and legal perspectives, as well as from the media. To reduce nutrients flowing into the Gulf from the Mississippi River, which has the largest drainage in North America, US EPA developed the Gulf Hypoxia Action Plan in 2008, and Illinois completed the Nutrient Loss Reduction Strategy (NLRS) in 2015 for use as a roadmap to achieve the following necessary nutrient reductions in the state:

Nutrient	Interim Milestone (2025)	Target
Nitrate-nitrogen	15%	45%
Total phosphorus	25%	45%

Water quality data collected in Illinois rivers and streams over the past three decades suggests that annual loadings of nitrogen and phosphorus continue to rise despite efforts to implement more conservation practices and reduce pollution. Annual nitrogen and phosphorus loads average at approximately 412 million lbs and 35 million lbs, respectively, with fluctuations reflecting variability in annual flow conditions.[1] The NLRS estimates annualized costs over $800 million to achieve meaningful nutrient reductions in Illinois.[1] Agricultural conservation programs offered by USDA in Illinois between 2011 and 2014 provided approximately $150 million per year while US EPA's Section 319 Grant Program to address the full range of nonpoint source (NPS) pollution funded about $6.5 million for projects in the state.[2,3] Furthermore, facilities that discharge wastewater into Illinois waters are facing increased pressure to reduce their nutrient loads. To meet NLRS goals and obligations under the Clean Water Act, point sources are committing to significant infrastructure investments, novel governance structures, and technological innovations for resource recovery.

A potential gap of over $600 million a year to support NLRS implementation illustrates that current policies and voluntary conservation programs, both in terms of financial capacity and implementation levels, will not be sufficient to achieve the long term reduction targets. Implementation of conservation practices at much higher levels across the state, as well as diversification of crops and cropping systems that reduce nutrient losses, will be necessary to see impact. To close the gap, there is a need to leverage and develop new market based solutions that can disrupt the status of quo in ways that incentivize conservation innovation and unlock new funding streams to make agricultural food systems economically and ecologically sustainable. Market mechanisms vary greatly, though they have the potential to integrate and amplify actions across the value chain from producers to retailers to investors, driving changes in cropping systems more efficiently and providing financing for conservation practices.

This white paper provides an overview of existing and potential market drivers that can be leveraged to improve water quality and soil health given the ambitious nutrient reduction targets adopted by the state.

ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY

While water quality has improved dramatically since the passage of the Clean Water Act, excessive nutrients in waterways continue to cause impairments in the Great Lakes, the Chesapeake Bay, and in the Gulf of Mexico. To address the water quality issues in the Gulf of Mexico, US EPA and states contributing to the loading of nutrients, nitrogen and phosphorus, into the Mississippi River have agreed upon aggressive reduction targets (45% reduction from baseline) and developed plans to achieve them. The Illinois NLRS synthesized decades of water quality data in Illinois and illustrated the pervasive nature of the problem - since the 1980s, nutrient loads have remained consistent despite significant investment in voluntary conservation measures (**Figure 1**). In order to be able to cut the amount of nitrogen and phosphorus entering Illinois waterways by nearly half, it is important to understand the existing land use and land management trends behind what ends up in the rivers and streams that ultimately drain into the Mississippi River Basin.

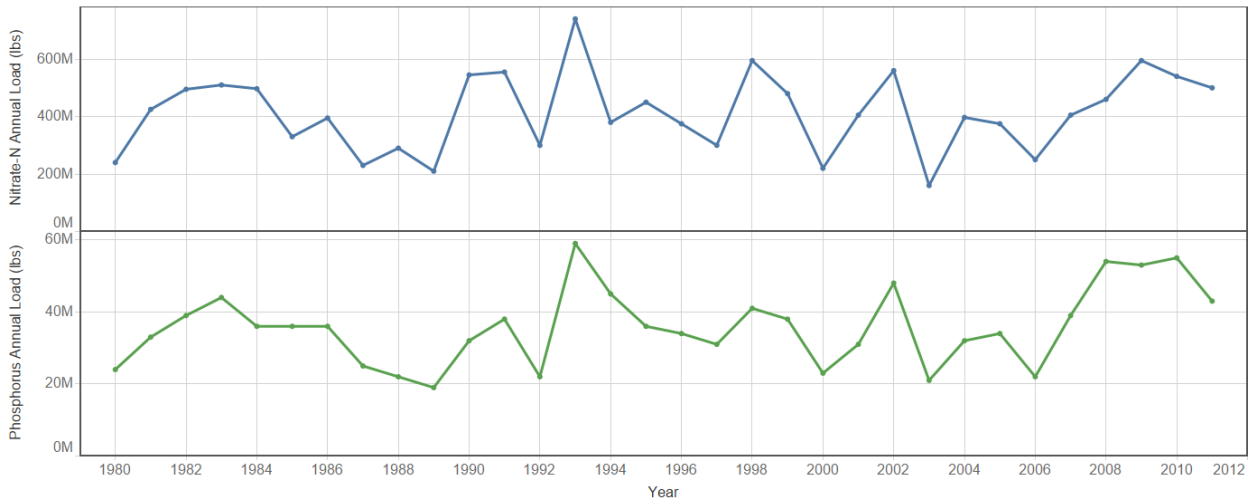


Figure 1 Annual Illinois nutrient loading from 1980 to 2011. Top panel: nitrate-nitrogen; Bottom panel: total phosphorus. Fluctuations correlate closely with riverine flow, see NLRS for primary data – Figure 3.3. Note: the values are approximate - reproduced from

Approximately 60% of Illinois land is in row crop agriculture, ranking 2nd in the US in corn and 1st in soybeans, as shown in **Figure 2**. According to the USDA-NASS Cropland Data Layer for Illinois in 2016 the major crops by acreage is: 11.5 million acres of corn, 9.6 million acres of soybeans, 324,000 acres of soybean /winter wheat (double-cropped), and 110,000 acres of winter wheat.[4]

Most of the remaining land use is made up of 5.7 million acres of forest, 3.2 million acres of grass and pasture, and 4.2 million acres of developed areas. Furthermore, there are 1,660 facilities that discharge into Illinois waters, with 263 facilities designed to handle at least 1 million gallons per day. This list also includes the 7 facilities operated by the Metropolitan Water Reclamation District of Greater Chicago, among them, the largest wastewater treatment plant in the world. As such, both,

agricultural nonpoint sources and permitted point source facilities are significant contributors to nutrient loading into the Mississippi River Basin, with the breakdown as follows:

Nutrient	Agricultural	Point Sources	Urban Runoff
Nitrogen	80%	18%	2%
Phosphorus	48%	48%	4%

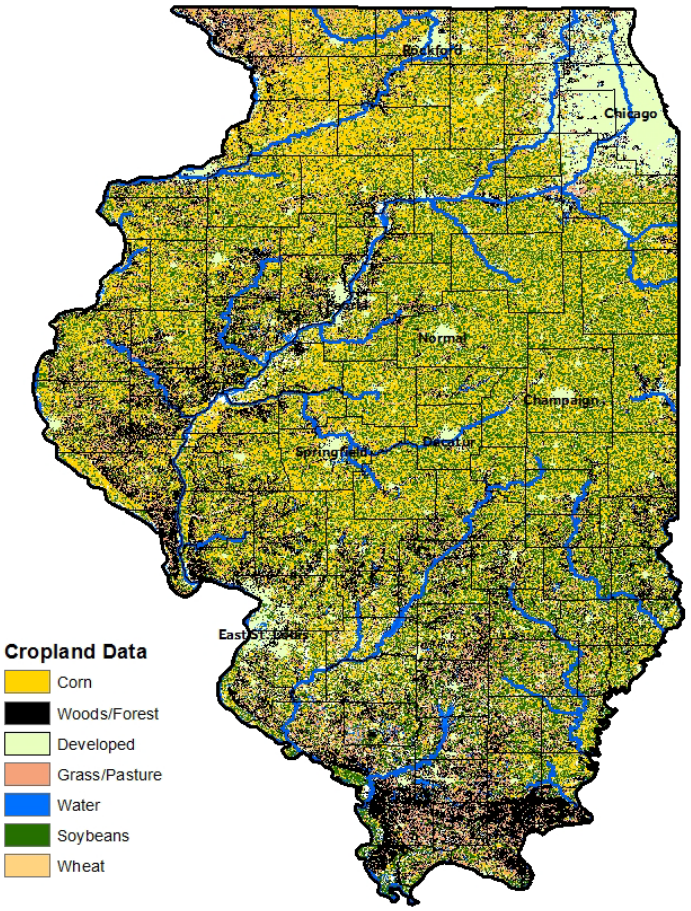


Figure 2 Illinois land use and crops for 2016.

In regard to achieving nitrogen reductions needed, it is important to recognize that average nitrogen application rates for most common crops in Illinois have remained steady (**Figure 3**), with corn consistently ranking highest for nitrogen intensity at about 160 lbs of fertilizer applied per acre. Historical trends for key crops planted and corn prices in Illinois can be found in the Appendix. In 2014, the most recent year for which data is available, USDA reported that over 1.9 billion lbs of nitrogen fertilizer was applied on Illinois corn acres. On average, Upper Midwest corn crops can expect to lose 22% of nitrogen applied through subsurface and surface flows (60% used by the crop, with the remaining 18% lost through volatilization and windborne sediment).[5] Comparing this to

documented nitrogen loads shown in **Figure 1**, nitrogen loading from corn would total roughly 422 million lbs (22% of 1.9 billion). It's apparent, then, that nitrogen application and loss associated with corn production dominates nitrogen dynamics in Illinois.

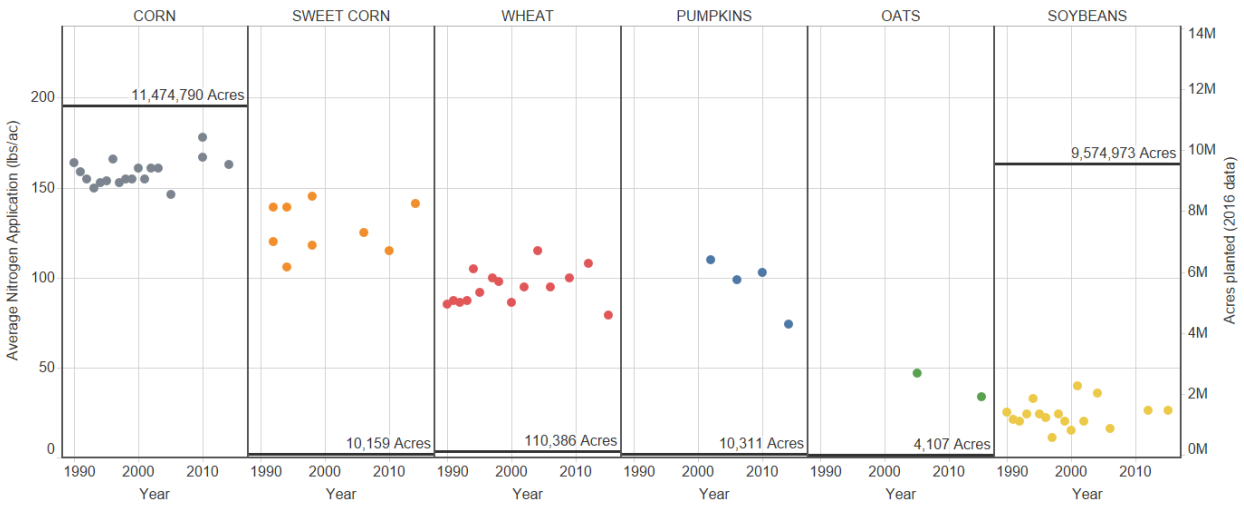


Figure 3 Average nitrogen application rates (lbs/ac) for common crops produced in Illinois between 1990 and 2015. The secondary axis shows the total crop acres planted for each commodity. Data Source: USDA National Agricultural Statistics Service.

Due to the significance of the nutrient contribution from agricultural sources, with row crops such as corn and soybeans in particular, the NLRS identifies a suite of agricultural conservation practices to serve as a roadmap for reaching the reduction targets. The strategy also models potential reductions associated with their implementation. The scenarios are based on Major Land Resource Areas (MLRAs) in the state and assess nitrogen and phosphorus reductions from a range of practices including edge-of-field, in-field, and land use changes. These practices include installation of bioreactors, buffers, conservation tillage, cover crops, nutrient management, perennial & energy crops, and wetlands (detailed in the Appendix). The Conservation Cropping System (CCS) strategy, which calls for a more holistic approach to conservation aimed at enhancing soil health and function alongside productivity and environmental protection, also includes practices such as employing extended crop rotations, drainage water management, and strip crops.[6]

Because these practices form the basis for the implementation of the NLRS, the discussion about the potential capacity of various market mechanisms will begin to establish linkages between the approaches proposed in NLRS and what could be feasible as part of employing a particular market strategy. The priority watersheds identified in the NLRS and categorized based on significance of the contribution from agricultural and point sources (see map in the Appendix) will inform which market mechanisms have the potential to be successful and areas to test and apply them.

There is no doubt that producers in Illinois respond to global market signals. Current corn prices are currently half of their peak value in 2012 (see Appendix for historical trends), leading to decreased returns for farmers. Already, USDA expects to see a large acreage shift from corn to soybeans in 2017 and projects that corn prices will remain near current levels through the next decade ($3.30 to $3.70 per bushel).[7,8] The low price regime for corn could lead to a system where market drivers can create tipping points for agricultural production in Illinois and beyond. Illinois decision makers, conservationists, producers, and other stakeholders seeking to improve water quality in Illinois should be prepared to harness and develop market mechanisms in the successful implementation of the NLRS.

MARKET DRIVERS

Defining Market Drivers

Nutrient loss in Illinois has been driven by market dynamics that have not fully taken into account the negative environmental externalities of production. While this can be viewed as a market failure, there are opportunities to use a suite of market drivers to reduce nutrient loss and improve the performance of Illinois agriculture. Local and regional water quality externalities are poorly constrained, and there has been limited uptake of technology, policy, or financial mechanisms to address this complex set of challenges. There are several market-oriented mechanisms that can be implemented to help to realign the public and private benefits from Illinois agriculture. Each of the example programs or initiatives described in this section is applicable in Illinois, and in broader geographies as well (**Table 1**). Specific programmatic examples are drawn from across policy, supply chain, land valuation and leasing, and supporting innovators. While each of these interventions could be piloted and scaled independently, there are synergistic opportunities between many of the programs that could be leveraged for greater ecosystem improvements. The programs highlighted here are designed for a range of stakeholders. They include capital markets, investors, supply chains, states and municipalities, and producers. There is always an interplay between market drivers in a globally connected marketplace, and the content here is focused on innovative market approaches that could have a measurable impact on Illinois nutrient loss.

Market Driver	Scale	Readiness/Feasibility	Barriers	Actions needed to overcome barriers
State revolving funds	Statewide implementa-tion, project scale	Established mechanism, but few ag NPS projects; Need to grow participation, and link with revenue generating activities	Illinois has a poor bond rating to grow fund; loan repayment; Higher priority of non-NPS projects	Incorporation of language in revised SRF rules that prioritize agricultural nutrient focused projects.
Watershed protection utility	Statewide implementa-tion	Conceptual; Need broad buy-in and likely legislative authorization	Non-conventional partnerships and new governance structure	Establishment of statewide governance structure as a Special Purpose District (via legislation) or a Public Utility (via petition to the Illinois Commerce Commission)
Pay for performance	Field to watershed scale	Piloting	High frequency & resolution data needed; Lack of numeric nutrient standards	Network of real time in-field and stream monitoring stations; Establishment of nutrient water quality standards
Supply chain partnerships	Field scale to statewide	In progress	Lack of financial/technical support to producers	Additional public and private support for technical assistance in CCS.
Consumer demand	Direct demand driver	In progress, opportunity for large growth	Need to create more demand; Consumer education	Dedicated marketing campaign around the food, health, and environmental benefits of CCS.
Land valuation	Field scale	Conceptual	Lack of explicit connection between soil health and land value; unanticipated negative outcomes	Research into soil health/land valuation connection and design of pilot framework.
Financing soil health	Field scale	Conceptual	Rigidity of government programs, unclear pathways to market-rate returns	Quantified financial risk/returns from CCS needed to change lender underwriting practices
Lease agreements	Field scale	Piloting	Increased complexity	Identification and outreach to landowners, development of template lease agreements
Risk mitigation innovation	Field scale	Conceptual	Limited replicability or data to support expansion of practices and programs	Incorporating new types of risk mitigation into USDA's FSA, RMA, and NRCS programs.
Investors and materiality	Supply chain with variable scaling	In development	Lack of adoption by regulatory agencies, long supply chains with distributed responsibility for negative externalities	Development of framework to distribute responsibility of nutrient pollution across the supply chain.
Continuous Living Cover	Field to landscape scale	In development	Adoption of practices by producers	Plant breeding, agronomic system development, markets for novel crops.

Table 1. Overview of market drivers that can be developed and implemented in Illinois.

Financing Innovations in Nutrient Reduction

Low-cost pollution control financing

The State Revolving Fund (SRF) is a permanent, independent source of low-cost financing for eligible recipients to control pollution and improve environmental quality. The SRF includes basic loans, purchase or refinancing of debt, guarantees and insurance, guaranteed SRF revenue debt, loan guarantees, or additional subsidization. Illinois EPA administers two SRF loan programs: the Public Water Supply Loan Program (PWSLP) addressing drinking water systems and the Water Pollution Control Loan Program (WPCLP) focusing on wastewater and stormwater infrastructure.

In Fiscal Year 2017, Illinois allocated approximately $386 million for the WPCLP.[9] While this may not be a financing strategy applicable to particular conservation practices, **the Clean Water Initiative expanded eligibility of the loan program to include nonpoint source pollution control projects related to agriculture and stormwater management.** The state agencies issue loans for conservation programs and local jurisdictions, and publicly owned treatment works (POTWs) apply and use loans for their conservation programs with direct linkages to water quality or protection. Examples of projects that can receive WPCLP loans include: "Publicly-owned septage receiving facilities, urban stormwater runoff, stream corridor restoration, forestry best management practices, development best management practices, agricultural runoff controls, 'green' infrastructure, and other nonpoint source pollution control projects as allowed under the Clean Water Act (CWA) Section 319(h) and Illinois EPA's NPS Management Program."[9]

The SRF provides a reliable source of funds to recipients who want to start conservation programs related to water quality or source protection with guarantees in place for repayment of the loans. Currently, the SRF is primarily utilized by point sources or municipalities to implement pollution control projects and programs, including nutrient reductions, due to their ability to generate revenue to pay back the loans.

For agricultural conservation programs to be able to utilize this financing mechanism, the conservation program needs to be economically beneficial and identify additional sources of revenue to pay back the loan. Pending approval of draft rules, private entities will also be eligible to apply for direct loans for NPS pollution controls. Illinois EPA will also be incorporating BMP rankings (related to environmental and economic effectiveness) into the WPCLP scoring system. Proposed rankings for the practices in the NLRS vary: constructed wetlands and bioreactors rank high, implementation of CCS as well as all but one other NLRS practice are ranked medium with the exception of perennial/energy crops, which are not included.[9] The expanded scope of the program will need to be coupled with additional outreach and administrative support to grow participation among producers. Iowa has developed and adopted a number of programs that expand the SRF for financing NPS projects. Local Water Protection and Livestock Water Quality Programs work with a

network of lenders and Soil and Water Conservation Districts to finance eligible projects complementing cost-sharing conservation programs, providing approximately $5 million in low interest loans in 2016. Iowa SRF also created a Sponsored Projects Program that allows for financing of restoration projects and NPS pollution control practices through an innovative approach that allows the borrowing utility to support a NPS project in the area. These sponsored projects are funded by a portion of the loan interest on the traditional infrastructure financing loan.

To expand capacity in the near-term, the SRF programs may issue bonds guaranteed by SRF funds. The revenue generated is used to provide assistance to borrowers. A green bond is designated for specific eligible projects addressing environmental issues. The green bonds may be issued by the government agencies and sold to investors for a set term. The entities that buy the bond expect a safe return on their investment. Organization and local jurisdictions use the proceeds from the sale of the green bond to fund conservation work. The green bond market has been expanding rapidly in the past several years with $81 billion issued in 2016 globally, with 14% of proceeds used for water projects and another 2% for agriculture and forestry projects.[10] Among government agencies in the Midwest, in 2016: the City of Cleveland issued its first green bond for wastewater management ($32.4 million); the City of Saint Paul issued green bonds for sustainable water ($7.7 million); and the Indiana Finance Authority and Iowa Finance Authority issued green bonds for wastewater and drinking water projects for $115.8 million and $163.3 million, respectively.[11,12]

While this is a good financing mechanism in certain states, this currently may not be feasible in Illinois due to its current bond rating. The use of green bonds may be more viable in local counties and municipalities with better bond ratings. Bonds also require a source of revenue for repayment, such as charges to water utility customers, and additional third party certification of the green bonds would ensure increased impact and transparency.

Watershed protection utility

During the Mississippi River Nutrient Dialogues of 2013 and 2014, a process led by the U.S. Water Alliance with contributors from across the Basin, the watershed protection utility emerged as one of four key strategies to address excess nutrients in a collaborative and long-term manner.[13] The resulting report describes this quasi-public utility as integrating efforts around watershed-based leadership, market mechanisms, and robust data infrastructure. This structure closely resembles the "water resources utility of the future" concept developed in a 2013 joint report by the National Association of Clean Water Agencies, Water Environment Research Foundation, and Water Environment Federation.[14] In both visions, the utility model shifts from centralized treatment of wastewater to strategic partnerships for reuse and recovery of valuable resources.

Illinois could establish a watershed protection utility as a novel institution to coordinate and distribute funding for the most cost-effective nutrient loss reduction projects across the state,

accelerating the pace of implementation through a more streamlined process. As a formal mechanism for linking point source demand to NPS supply of nutrient reductions, this concept would also be compatible with a pay-for-performance approach to rewarding farmers for their conservation efforts. Depending on its legal structure, the utility could be funded by a variety of sources ranging from grants to a new surcharge on water bills. Though the NLRS charged the Policy Working Group with further investigating this concept, no developments have been reported publicly beyond their initial meetings in late 2015. During that time, the Metropolitan Water Reclamation District of Greater Chicago (MWRD) announced the launch of a stakeholder steering committee and a white paper to demonstrate the feasibility of the concept. According to a discussion draft from February 2017, the utility is envisioned as a management company dedicated to meeting the objectives of NLRS by directing investment into the lowest-cost nutrient reductions across the state.

Leveraging Supply Chains

Supply chain partnerships

In recent years, the agricultural sector has launched numerous initiatives to educate and support voluntary nutrient loss reduction. These have ranged from N-WATCH, an on-farm soil testing program in Illinois, to the 4R Nutrient Stewardship Certification Program for agronomic service providers, to partnerships that establish goals for the entire supply chain. In August 2016, the Midwest Row Crop Collaborative (MRCC) was launched to support implementation of agricultural conservation practices in Illinois, Iowa, and Nebraska where row crop agriculture plays a significant role in excessive nutrient loading in the Upper Mississippi River Basin. In addition to addressing water quality impairments, MRCC will be working to address greenhouse gas emissions associated with fertilizer use and depletion of groundwater in the Ogallala Aquifer. The founding members of MRCC include Cargill, Environmental Defense Fund, General Mills, Kellogg Company, Monsanto, PepsiCo, The Nature Conservancy, Walmart, and World Wildlife Fund. The companies involved are key players in the food production (primarily corn, soy, and wheat) value chain from seeds to retail.

There is direct alignment between the targets set in the Gulf Hypoxia Task Force action plan, and the respective state nutrient reduction strategies, and MRCC's goals. Ultimately, by 2035, MRCC actions would lead to Illinois, Iowa, and Nebraska meeting the 45% nutrient loss reduction goal, and expanded partnerships and goals across the Upper Mississippi River Basin. As interim goals, MRCC aims to achieve the following by 2025:

- 75% of row crop acres in Illinois, Iowa, and Nebraska are engaged in sustainability measures utilizing Field to Markets Fieldprint Calculator to optimize water quality and soil health outcomes.

- 20% reduction of nitrogen and phosphorus loading from Illinois, Iowa, and Nebraska as a milestone to meet agreed upon Gulf of Mexico Hypoxia Task Force goals.
- 50% of all irrigation units used in Nebraska will maximize water conservation to reduce pressure on the Ogallala Aquifer

The MRCC strategies to achieve these goals include engaging farmers through the Soil Health Partnership and providing training and technical support to increase adoption of cover crops and fertilizer optimization practices. These practices align with several of the practices highlighted in the Illinois NLRS. In particular, a concerted effort to increase cover crop implementation in Illinois has the potential to reduce nitrogen and phosphorus losses by 30% (per acre), and 50% phosphorus reduction for extended rotations. Fertilizer optimization practices, such as nitrification inhibitor application, split applications, and rate optimization, could reduce nitrogen losses by 7.5-20%, depending on simulation parameters.

The MRCC will utilize Fieldprint Calculator as a tool to optimize for environmental outcomes, which is already integrated into the companies' responsible sourcing goals more broadly. Walmart also uses Adapt-N to support their fertilizer optimization goals in the sustainability index applied to their supply chain. Though these tools seem to be well aligned with the focus of the collaborative, their use by growers, crop advisors, and on-the-ground conservation professionals is currently limited. The Collaborative's ambitious targets have the potential to drive consequential changes in Illinois cropping systems. Kellogg, General Mills, and PepsiCo include corn, soybeans, wheat, and oats among the top 10 priority ingredients in their sustainable sourcing targets for 2020. General Mills' 2016 Sustainability Report indicates that only 26% of the corn in their production chain meets the standard.[21] Furthermore, Walmart's 2020 target is to ensure that its top food suppliers work with farmers to optimize their fertilizer use and reduce greenhouse gas emissions on 10 million acres of corn, wheat, and soybeans. Protecting soil, managing nutrients, and optimizing productivity for crops such as corn and soybeans are key components of Monsanto and Cargill sustainability goals as well. By building local capacity and offering producers and agricultural professionals in Illinois technical resources and support, MRCC can catalyze implementation of practices that will help them make progress toward nutrient reduction targets.

Continuous Living Cover

New agronomic approaches and plant breeding efforts have focused on creating or adapting varieties of plants that will not only develop novel cropping systems, but will create marketable products. One example of such a cropping system is a Continuous Living Cover (CLC) farming system.[22] The goal within CLC systems is to maintain living roots in the soil throughout the year, **leading to increased carbon sequestration, decreased erosion and nutrient loss, and improvements in soil health.** Strategies to maintain CLC systems can be achieved through the

combination of cover crops, perennial forages, agroforestry, perennial biomass, and perennial grains.

Although widespread adoption is limited as many elements of CLC systems are still being developed and the planted acreage of these crops are low, revenue-generating crops like Kernza®, pennycress, and winter camelina are beginning to enter the marketplace. Kernza® is the trade name of an intermediate wheatgrass developed by The Land Institute as part of their broader portfolio of perennial polyculture crops being developed.[23] While it has been in development for nearly 30 years, recently there has been significant excitement in the marketplace these sustainable crops. In 2016 Patagonia Provisions released a beer containing Kernza®,[24] and in 2017 General Mills announced that they would be incorporating the grain into their Cascadian Farms products.[25]

Pennycress and winter camelina are two other crops being developed for use in CLC systems. These crops are fall planted and harvested in early summer, producing greater revenue per acre than traditional cover crops. Camelina can be pressed into food-grade oil and presents an alternative to other cooking and baking oils. Pennycress can be used for biodiesel and is being commercialized by Arvegenix26.

These three crops are examples of market-driven solutions that provide revenue for farmers and reduce nutrient loss by maintaining living roots in the soil. Research, development, and market-building will continue for these crops and agronomic systems, hopefully demonstrating a viable and scalable approach that benefits producers and the environment. Implementing CLC systems and keeping the soil covered throughout the year can also provide additional opportunities to generate income to maximize the generation of saleable products.

Opportunities for consumers to drive agricultural conservation

Commodity crops and the systems that support their development are well understood, well developed, and create an efficient movement of goods from sellers to buyers. This creates a transparent transaction process that facilitates market success. In order for CCS to be more widely adopted, the same market efficiencies must exist that facilitate the development of a diverse production system of food, feed, fiber, and fuel.

Consumers hold a lot of untapped power in driving agricultural conservation. While sustainable agriculture encompasses more than just organic farming, organic farming serves as a good proxy to demonstrate that the market could support increased production levels of sustainable crops. While the USDA reported that organic sales reached $37 billion in 2015, the Organic Trade Association found that demand for organic dairy and grains could have supported a further increase in production.[27,28] Consumer demand for differentiated food products continues to grow the market

and drive further production.[29] However, according to USDA, in 2015, there were only 168 organic farms, roughly 0.3% of all operations in the state, with $35 million in total sales.

In addition to organic products, consumer demand in Illinois will likely continue to shift toward healthy, nutritious, locally produced food. Already there are 1,377 operations in Illinois that directly market their products, with $71 million in sales in 2015. Polling of residents in East Central Illinois counties conducted in 2015 by Illinois Environmental Council also indicated that 40% consider sourcing when buying food, and 67% report buying locally grown food some or most of the time (exceeding respective characteristics for organic food). Initiatives such as Regenerate Illinois and the Artisan Grain Collaborative are focused on addressing barriers to growing these markets. Regenerate Illinois, a consortium of stakeholders that is focused on restoring soil health in the state through regenerative agriculture, and the Artisan Grain Collaborative, a collective of practitioners interested in building and strengthening the value chain for diverse grains, have both formed in 2016 to support the markets for regenerative agricultural practices. Initiatives such as these are promoting distribution, processing, and marketing to move products to market and are helping grow the consumer base that will drive demand. Furthermore, they encourage adoption of agricultural systems that promote a holistic approach to land management which will result in reduction of erosion and nutrient losses. By supporting and growing these and similar initiatives, which demonstrate to value chain partners that demand exists, new markets will be created.

In addition to organic certification, there are other state based certification programs that indicate to environmental sustainability consumers. For example, the Michigan Department of Agriculture (MDA) currently operates the Michigan Agriculture Environmental Assurance Program (MAEAP) that assists farmers and operators on a voluntary basis to prevent or minimize agricultural pollution risks on all farms and all commodities. The program has a three-phase process that includes educational opportunities and workshops for interested parties, on-farm risk assessments conducted by certified MAEAP conservation technicians, and a third-party verification making sure that the risks that were identified were addressed and mitigated. The program's four systems - (1) Farmstead, (2) Cropping, (3) Livestock and Forest, (4) Wetlands and Habitats - examine different aspects of the farm. Once the proper systems are identified and the three-phase process has been completed, the farm will then be enrolled into the MAEAP program and can display a sign on their farmstead indicating their certification.

The MAEAP program was launched in 1998 with the first verification taking place in 2002. As of November 2016, 10,000 farmers have started the verification process and more than 3,300 farms have been verified. In 2013, an estimated 347,000 tons of sediment, 592,000 lbs of phosphorus and 1,353,000 lbs of nitrogen have been reduced through implementation of BMP's on certified MAEAP farms.

The 5 STAR (Saving Tomorrow's Agricultural Resources) program, created by the Champaign Soil and Water Conservation District (CSWCD) in Illinois, aims to work with all producers and landowners in Champaign County to assess agronomic practices on all tillable parcels. The landowner or producer will complete a survey regarding crop rotation, tillage practices, nutrient application practices, and best management practices that are currently implemented on their farm. Staff from the CSWCD will then assign a star rating to that particular farm based on the survey results. After a star rating has been assigned, staff will conduct an on-farm visit to assess and offer recommendations on best management practices for improved environmental outcomes.

Another example of a certification program that incentivizes conservation in response to consumer pressure is one developed by Louisiana State University. The Master Rice Grower Program provides incentives to qualified farmers for following sustainable production practices. There are four levels of participation in the program (bronze, silver, gold and platinum), all requiring different levels of participation ranging from attending educational workshops to implementing conservation plans. The farmer will also receive a financial incentive per barrel, depending on their current level.[31]

Similar efforts driving conservation cropping techniques could be implemented in Illinois to create the demand that will drive the establishment of market efficiencies within the value chain. A statute enacted by the Illinois General Assembly in 2000, called the Illinois Rivers-Friendly Farmer Program, was created to promote farming practices that benefit rivers while maintaining farm profitability and to inform the public about farmers' contributions to cleaning up the rivers of Illinois.[32] A farmer seeking the designation may submit a written application to the Department of Agriculture or any agency designated by the department. To receive the designation, farmers need to satisfy the following criteria: soil loss on cropland is at or below the tolerable soil loss level, an approved conservation plan is on file, and vegetative filter strips are implemented.[32] While the Illinois Rivers-Friendly Farmer program has been inactive since 2005 due to lack of staffing and resources, it can be amended in the future to include more aggressive standards coupled with financial incentives for implementation of conservation practices and advancing the NLRS.

Frontiers in Risk Mitigation

Agriculture is inherently risky. Changes in weather and markets can jeopardize farm revenues, and while the USDA supports crop insurance, there are limited incentives to reduce exposure to environmental risks and incentivize innovation in risk mitigating approaches to production. Further up the supply chain, new questions have emerged about the equitable distribution of responsibility from environmental damages from certain production practices between producers and consumers. **While there will always be some elements of risk, there is an emerging set of approaches that scale from the farms to capital markets that could be used to better account for and manage agricultural risk, providing new opportunities and incentives to reduce nutrient losses from Illinois.**

Exposure to water risk in Illinois was compiled using the Aqueduct water risk indicator tool (**Figure 4**), and characterized a majority of Illinois as "high risk" by using a comprehensive set of biophysical and socioeconomic indicators.[33] The high risk areas in Illinois could benefit from the implementation of CCS as a risk mitigation approach. Increasing soil organic matter, as a component of general soil health improvements would increase infiltration and water storage capacity and reduce run-off, reducing risks both locally and downstream. Even with the additional expected stressors from climate change, there are opportunities to mitigate risk from water and other types of environmental factors. These challenges can be addressed through several risk mitigation mechanisms detailed below.

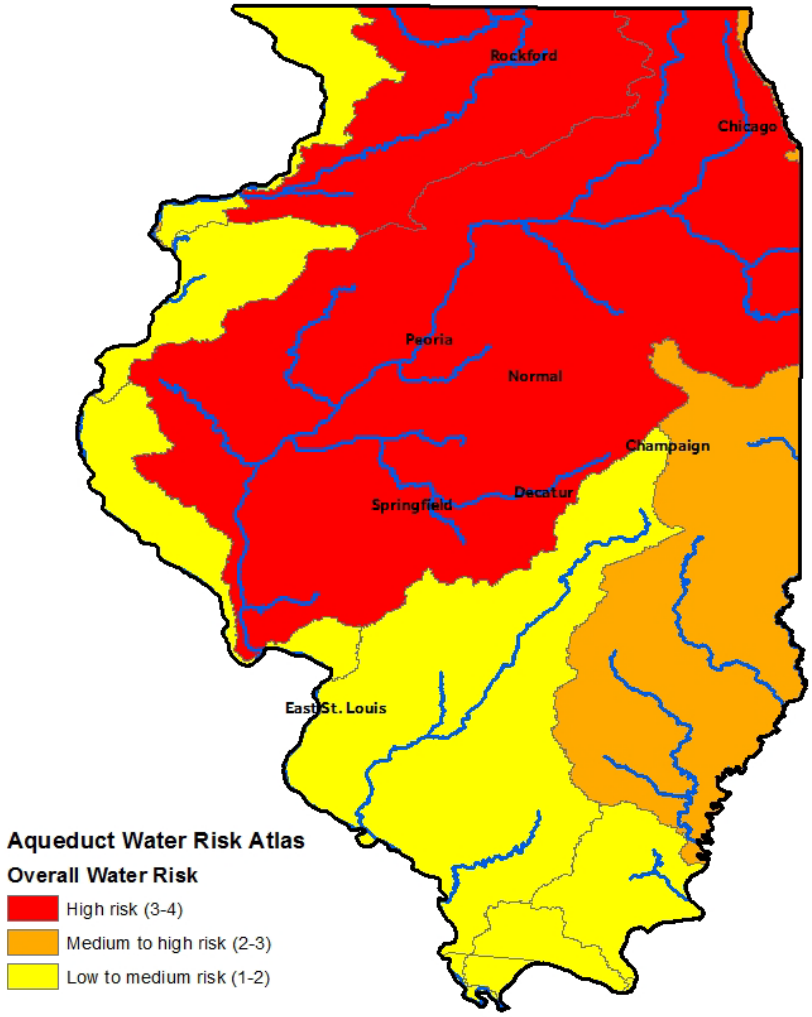


Figure 4 Water risk indicators for Illinois. As part of a global analysis, decision-relevant water risk indicators were calculated and are shown above for Illinois. The figure illustrates the overall water risk for Illinois, showing areas with higher exposure to

Reconnecting soil health to land value

The market value of agricultural land is determined by a mix of local and global economic, policy, and environmental characteristics. Currently, many of these factors are outside of the control of producers. In Illinois, one of the determinants of land value and cash rents is the productivity index, as defined by Bulletin 811.[34] Other states have devised similar mechanisms to connect productivity with land price or rents, like the Corn Suitability Rating 2 in Iowa.[35] Technology companies, like Granular, are also using complex data approaches to value land, as in their Acrevalue tool.[36] These approaches to land valuation discount the internal and external benefits provided by CCS, such as the ability of a healthy soil to facilitate nutrient cycling.

New approaches to land valuation and rental rate calculation are needed to differentiate management systems. While those that concentrate on maximizing productivity often have significant environmental externalities, CCS provides benefits to the producer in terms of carbon sequestration, water storage and drought risk reduction, nutrient cycling, and pest protection. There are few conceptual examples that are being developed, including the Australian based Soil Star.[37] Additional research and development is needed to better understand the trade-offs of modifying farmland valuation and the steps that would need to be taken to integrate this concept into practice. If land values for prime and healthy farmland were to increase, the ability for new and beginning farmers to access that land would decrease. Rental rates would also increase, decreasing producer profitability, unless a market premium was available for products produced on healthy soils. Specific communities that may be interested in this approach would be operator landowners, non-operator landowners, and investors. Each one of those communities has different interests in the short-term and long-term revenue generated by agricultural production that would need to be taken into consideration. In order to begin testing out this concept, the methodologies of professional communities, such as lenders, assessors, and appraisers who concentrate on farmland will need to be assessed. In Illinois, many of these professionals are represented in the Illinois Society of Professional Farm Managers and Rural Appraisers. While soil health may be an implicit component of land valuation, determining the appropriate ways to explicitly connect soil health to land value will help to determine the suite of market drivers that need to change in order to implement this potentially transformational market shift.

Innovations in financing for soil health

Agricultural production is tightly coupled with the financial sector, and innovations are necessary to leverage the power of capital to shift toward CCS and reducing risks for producers and value chains alike. Stranded assets are assets that are written-off, devalued, or converted to liabilities because of their exposure to environmental risks and changes in the market.[38] While this concept has mostly been applied to fossil fuels, it also has applicability to agriculture. For instance, management regimes that result in degraded soils might be more prone to extreme events; synthetic nitrogen fertilizer

could become more costly under climate policy; phosphate availability might be more limited in the future; and heavy tillage equipment might be seen as too risky in the future. Accounting for these risks within underwriting guidelines and other lending criteria might alter the way credit is distributed in agricultural systems. This presents an opportunity to work with investors, lenders, insurance companies, USDA, and companies in the agricultural value chain to better understand the current and future risks, and better align future capital formation with resource conserving and risk reducing agricultural management systems. While the underwriting / lending / insuring criteria and mechanisms differ across the financial supply chain, moving this concept toward implementation would need a thorough survey of the currently used financing criteria coupled with a roadmap for how each type of financing mechanism could be adapted to better support soil health and CCS.

Another example of innovative financing for CCS and soil health outcomes is being piloted by The Nature Conservancy as part of a USDA Conservation Innovation Grant.[39] The project works with commercial lenders and impact investors to reduce the rates of operating loans for producers that implement specific conservation practices that results is both public and private conservation and natural resource benefits. If successful, this approach could be scaled to other agricultural lenders, specifically in the farm credit system.

Leveraging lease agreements to improve conservation outcomes

Average lease terms for farmland in the state are between one and three years.[40] Leases of this length prioritize short-term yield over the adoption of long-term best management practices. One way to encourage more sustainable farming practices is to lengthen these leases or to execute ground leases which allows for increased security and planning on the part of the farmer. Longer term leases allow farmers to capture the investment they make in their fields and may allow them to increase their borrowing capacity.[41] Beyond lengthening leases, similar incentives include leasing with option to purchase, which allows farmers to recoup the investments they make. This strategy is employed by some sustainable farmland investment groups such as Iroquois Valley Farms. Long-term leases can also include rights of transfer and renewal which reassures farmers that the investment they make in sustainable practices and any benefits they receive can be passed on to the next generation.[42] Long-term leases, however, are often more complex, may make securing a loan more difficult, and may just as easily reduce net income in the long run for the farmer as well as the landowner depending on the market trends. Illinois agencies can play a role in guiding management decisions on cropland leased to farmers by the Department of Natural Resources, Department of Transportation, and Department of Agriculture. In 2017, the Department of Natural Resources held nearly 34,000 acres of land under farm leases, 8% of those acres are locked into 10 year terms under the federal Conservation Reserve Program. Most lease rates are at or below market rates.

The Sustainable Agricultural Land Tenure Initiative, a collaboration between Drake University and Iowa State University are exploring programs and policies that lead to agricultural sustainability and stewardship through lease agreements. The initiative aims to provide learning opportunities for

farmers, landowners, attorneys, educators, and public officials, with organizations such as Women Food and Ag Network making it a priority to utilize such resources. Furthermore, American Farmland Trust launched a three-year project in 2017 in two Great Lakes watersheds (Ohio's Portage and Toussaint Rivers and New York's Genesee River) to expand adoption of conservation practices on leased land particularly among women non-operating landowners. The project team also includes research institutions, on-the-ground technical assistance, and agronomic retail sector to enhance outreach and education on this issue. Lessons learned from such projects can help reform leasing agreements in Illinois, where 60% of cropland is leased, as well as other parts of the Midwest. Supporting the implementation of more long-term leases will support on-field and practice-based conservation. This will help achieve the scale up in practices needed to reach the agricultural nutrient reduction goals of the Illinois NLRS.

Opportunities to support innovation in risk mitigation

Crop insurance is an important tool to protect producers from many natural hazards. While the USDA supported programs have evolved since their inception in the 1930s to protect producers' livelihoods against the twinned threats from the Great Depression and the dust bowl, there is need for further reformation to encourage natural resource stewardship and reduction in nutrient losses. Insurance products are not directly tied to natural resource risk, or the use of CCS. There are early efforts[43] to demonstrate the correlations between conservation practices, like cover cropping and reducing risk. Innovators in this space, including representatives of the Soil Health Champions Network, have shown that using practices that increased soil organic matter have made them more resilient to droughts and less likely to require insurance payouts. More data are needed to better understand the relationship between CCS and risk mitigation, in order to formalize these relationships under existing USDA Risk Management Agency (RMA) programs, or other avenues outside of USDA.

Beyond government programs to help mitigate risks, there are limited mechanisms to incentivize producers to innovate in ways that have positive environmental and economic outcomes. **New programs are needed that either financially protect producers that implement novel conservation practices or provide upfront funding to test innovative practices.** Within these conservation innovation programs and across the broader agricultural system, efforts are needed to spread and scale the lessons learned from implementing conservation cropping systems. NRCS could collect agronomic and financial data from recipients of Farm Bill programs, and those data and others could be used to further document the internal and external costs of conservation measures.

Emerging mechanisms for investors

The U.S. Securities and Exchange Commission (SEC) is tasked with protecting investors, maintaining fair, orderly, and efficient markets, and facilitating capital formation. In an age of increasing transparency around the social and environmental impacts of economic activity, new

initiatives, like the Sustainability Accounting Standards Board (SASB), have begun to develop standards for the disclosure of material sustainability information that could be incorporated into SEC filings. SASB has developed standards for 79 industries, including both agricultural products and meat, poultry, and dairy. Inputs to agricultural production are included in the Resource Transformation and Non-Renewable Resource categories covered by SASB.

While producers themselves would not be impacted by regulatory disclosures, many elements of the supply chain could be affected if their activities could be shown to have material impacts on the financial health of the company. For instance, companies might need to disclose information on water withdrawals, greenhouse gas emissions, tillage practices, fertilizer consumption, animal welfare, and use of GMOs. There remains challenges in connecting farmer actions (e.g. fertilizer application and tillage) back to the companies that manufacture the equipment or the inputs. Metrics related to those disclosures may not have been material in the past, but investors are more likely to consider sustainability related returns on their investments in addition to financial returns. Sustainability related disclosures from publicly traded companies that operate in the Illinois agricultural sector may be impacted if their services or products result in negative impacts that were material to the performance of the company.

TOOLS FOR QUANTIFICATION AND IMPLEMENTATION

Economic markets rely on good information to function. Similarly, management decisions should be guided by a robust assessment of economic and environmental benefits associated with those decisions. The variability inherent in ecological systems (hydrology, climate, soils, etc.) as well as cropping systems (rotations, drainage, nutrient application, and uptake) requires intensive monitoring efforts as well as development of models that capture a complex set of interactions and predict relevant environmental parameters. In recent years, many tools and advanced models have been developed. This section provides a brief overview of the tools and their suitability in guiding selection of practices relevant to the Illinois NLRS and evaluate their effectiveness (see Appendix for details about the tools).

	NTT	Adapt-N	Fieldprint	STEPL	ACPF	Practice type
Practices recognized in the IL NLRS						
Buffers			■	■	■	edge-of-field
Bioreactors					■	edge-of-field
Conservation Tillage	■		■	■		in-field
Cover Crops	■		■			in-field
N Rate Reduction	■	■	■			in-field
N Inhibitor Product		■	■			in-field
N Application Timing	■	■	■			in-field
Perennial/Energy Crops						in-field
Wetlands	■				■	edge-of-field
Practices recognized by AFT in the CCS strategy						
Crop Rotation	■		■			in-field
Drainage Water Management	■		■		■	edge-of-field
Strip Crops	■		■			in-field

Figure 5 The relationship between planning tools capabilities and agricultural conservation practices recommended for implementation in Illinois.

The tools highlighted represent a selection of publicly available platforms that are also commonly used by corporate sustainable sourcing initiatives or preferred by government agencies for evaluation and verification. Their capabilities range from estimating nutrient loads to prioritizing areas for siting specific practices to making optimizing fertilizer application regimes. **Figure 5** shows the overlap and gap between NLRS/CCS practices and the tools' abilities to model and estimate the resulting changes. For example, the Fieldprint Calculator can model most of the practices featured in the NLRS (plus several other practices), however nutrient reductions associated with planting perennial or energy crops are not directly addressed by any of the tools highlighted here. **The need**

for multiple tools to quantify results creates a barrier for producers and an inefficiency in synthesizing information in decision making and markets.

While this section provides a brief overview of a subset of publicly available tools, it's important to acknowledge that there are also numerous commercial agronomic tools in use that incorporate yet another set of different parameters and assumptions. Most of them focus on yield rather than attaining soil health and stewardship outcomes, but several are being evaluated through the Environmental Defense Fund's NutrientStar program. There are ample opportunities for better alignment and integration of these tools overall to support land management decisions and link to market signals.

CONCLUSION

The agricultural ecosystem in Illinois is continuously evolving. While the current system is very efficient in producing caloric output, there are many externalities of production, including the extensive loss of nutrients from the system. Looking forward, this white paper presents strategies to adapt, adopt, and invent mechanisms to revive rural landscapes and ecosystems, both in Illinois and in the geographies downstream. While there are a variety of interventions that could mitigate some of the existing challenges, there is a multitude of local and global forces at play involving policy, science, technology, culture, and market dynamics. The challenge in the decade ahead will be that we need to address all of these components of the Illinois agricultural system, realizing that they are embedded in regional, national, and global contexts.

While there are many drivers of change, this report focuses on market drivers that could be used to reduce nutrient loss in Illinois. Many of the market mechanisms explored herein are in need of additional development and support to help the Illinois agricultural community better meet (and exceed) the targets laid out in the Illinois NLRS. For instance, there is little consumer knowledge about the environmental impacts of production systems in Illinois, and the opportunities to improve them. Strategies borrowed from other agricultural sectors could be used to help bridge the gap between producers and consumers to improve the outputs and outcomes of the system in a more synchronous and transparent way. In addition to creating stronger connections between producers and consumers, there are opportunities to create partnerships between producers in different geographies to highlight the human and ecological impacts of nutrient loss. An example of this type of relationship is forming between a farmer-led watershed group in Wisconsin and fishermen from the Louisiana Bayou.[44] These types of interactions help to tell the human story of agriculture, which is a natural complement to the market component highlighted here.

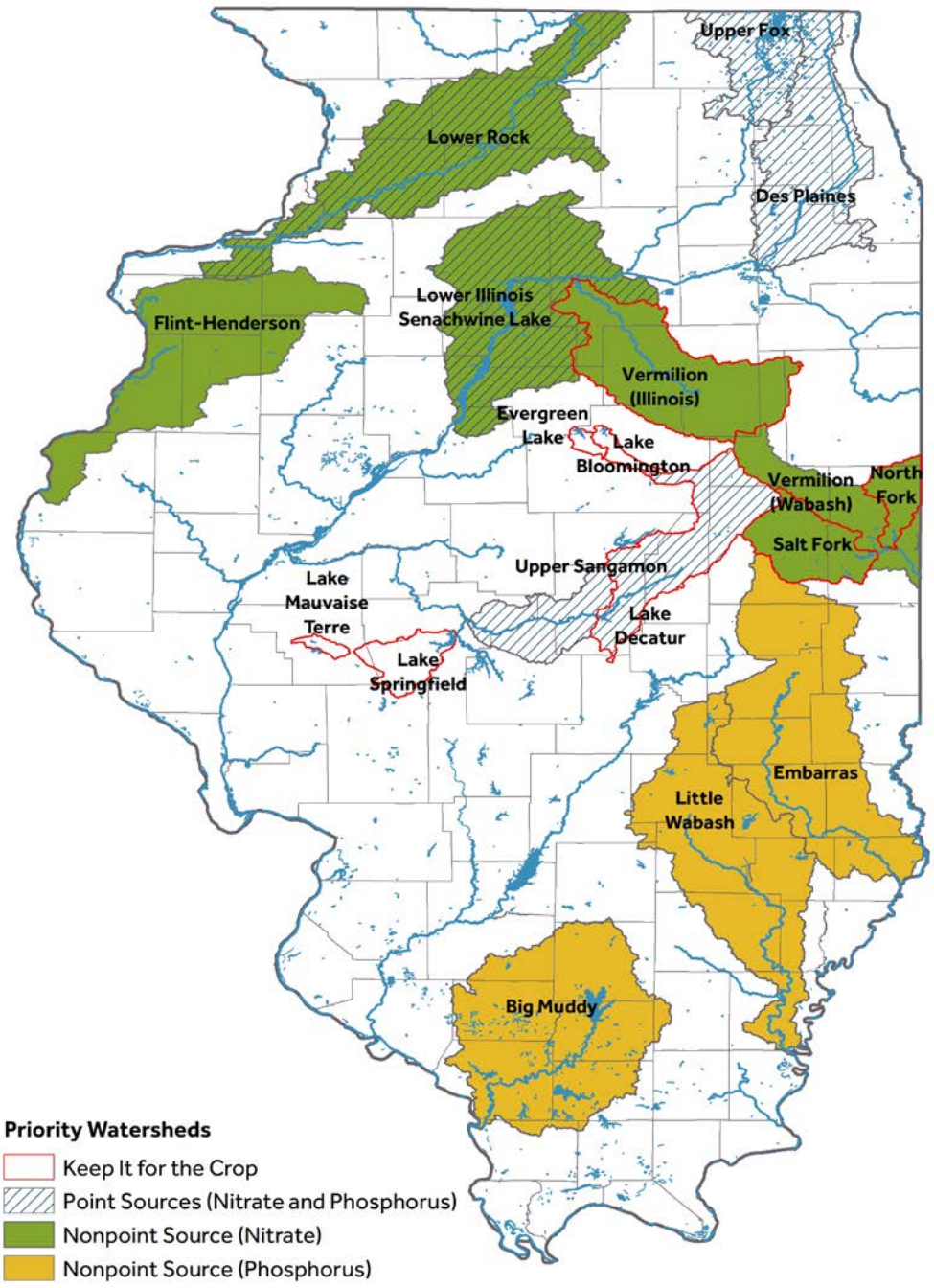
The challenges in reducing Illinois' nutrient loss will not be solved by one organization, policy or market intervention, but will require collaborative, forward looking, and solutions-based approaches to these complex challenges. There are no one-size-fits-all or turn-key solutions, but there are a number of opportunity spaces where the components needed to build the enabling infrastructure for new markets are ready to be deployed. Some of these components are familiar and ready, such as existing crop insurance mechanisms, that if tweaked could help promote CCS. Other components, such as agronomic tools and models have been developed for specific purposes, but could be refined to better meet challenges faced by producers and consumers alike, such as by increasing interoperability, portability, and adaptability to different production systems and end uses. Existing initiatives led by aligned value chain partners can push their boundaries in the pre-competitive space to accelerate the adoption of CCS while making their producers more profitable and their supply chains more resilient. The market driven elements of a more conservation oriented and nutrient conserving food system are all around us, the hard part is weaving them together in ways that work for producers, consumers, and the planet.

APPENDIX

Illinois NLRS implementation scenarios

Practices in the NLRS	NLRS implementation scenarios	Nitrate-N reduction per acre (%)	Nitrate-N reduced (million lbs)	Total P reduction per acre (%)	Total P reduced (million lbs)
Bioreactors	Bioreactors on 50% of tile-drained land	25	35	NA	NA
Buffers	Buffers on all applicable cropland	90	36	25-50	4.8
Conservation Tillage	1.8 million acres of conventional till eroding >T converted to reduced, mulch, or no-till	NA	NA	50	1.8
Cover Crops	Cover crops on all corn/soybean tile-drained acres	30	84	30	4.8
Cover Crops	Cover crops on all corn/soybean non-tiled acres	30	33	NA	NA
Cover Crops	Cover crops on 1.6 million acres eroding >T converted to reduced, mulch, or no-till	NA	NA	50	1.9
N Rate Reduction	Reducing N rate from background to MRTN on 10% of acres	10	2.3	NA	NA
N Application Timing	Spring-only application on tile-drained corn acres	15-20	26	NA	NA
N Inhibitor Product	Nitrification inhibitor with all fall applied fertilizer on tile-drained corn	10	4.3	NA	NA
N Application Timing	Split application of 40% fall, 10% preplant, and 50% side dress	15-20	26	NA	NA
N Application Timing	Split application on 50% fall and 50% spring on tile-drained corn acres	7.5-10	13	NA	NA
Perennial/Energy Crops	Perennial/energy crops equal to pasture/hay acreage from 1987	90	10	90	0.3
Perennial/Energy Crops	Perennial/energy crops on 10% of tile-drained land	90	25	50	0.3
Wetlands	Wetlands on 35% of tile-drained land	50	49	0	0

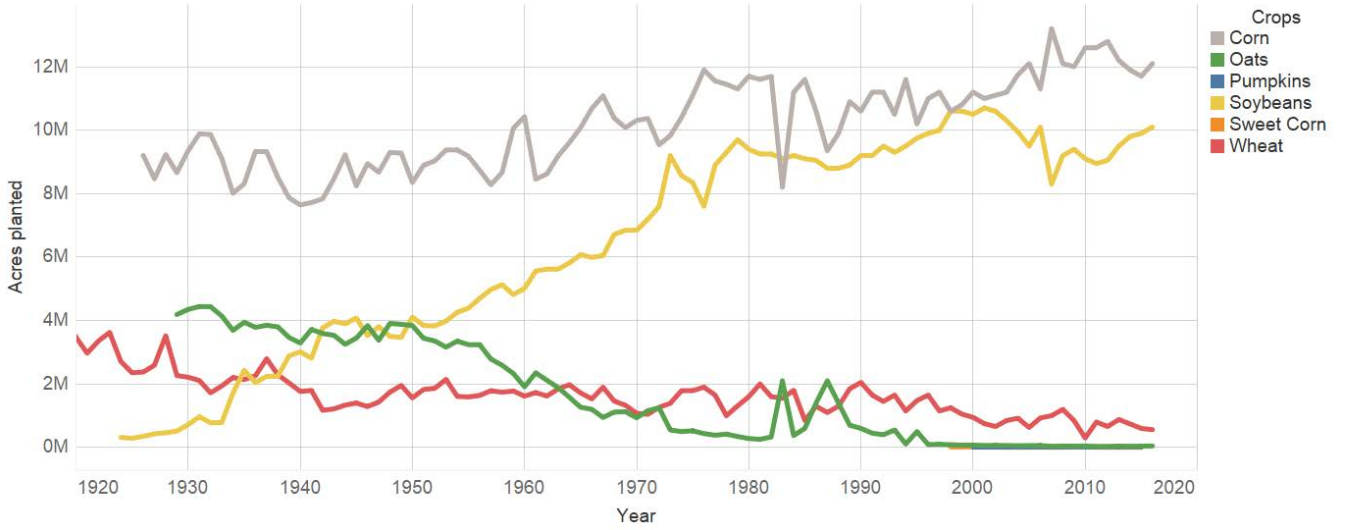
NLRS Priority Watersheds

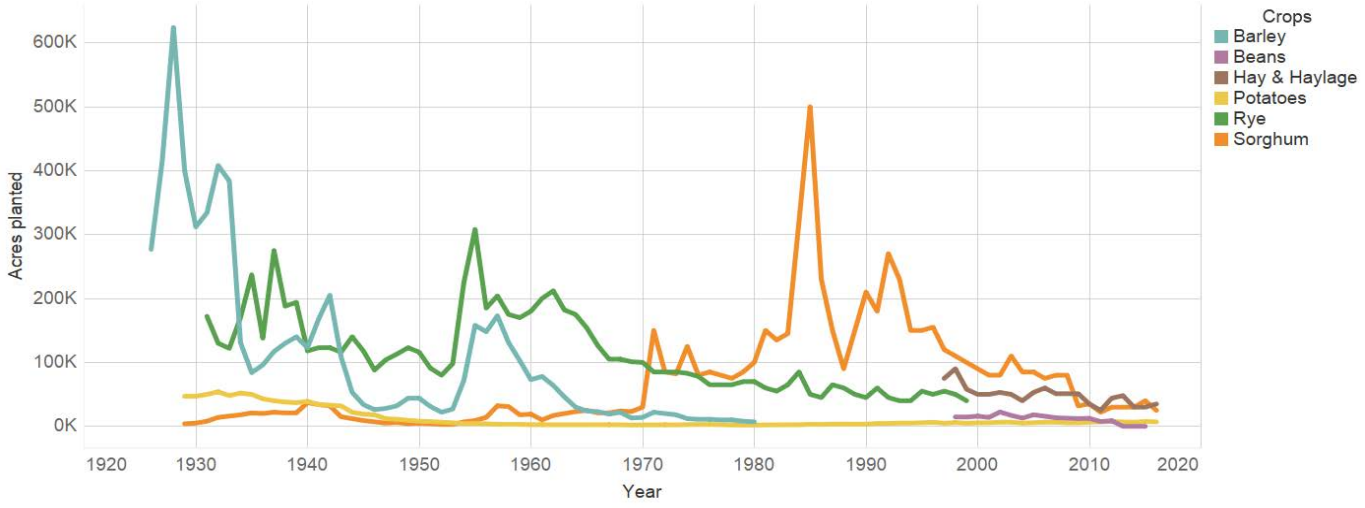


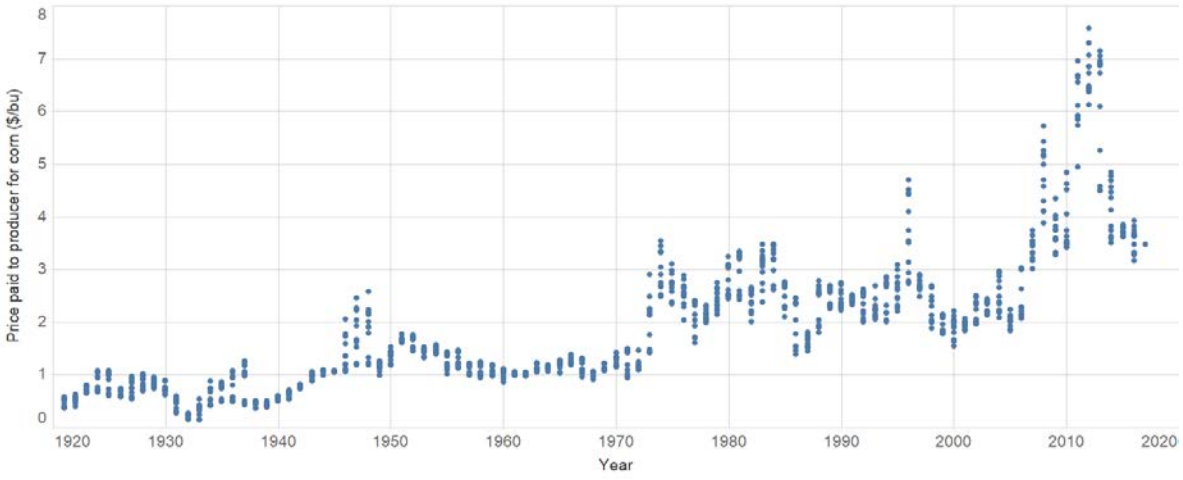
Tools Overview

Model/ Tool Name	Description	Data Inputs	Data Outputs	Spatial/ Temporal Extent	Developer	Intended Audiences
Nutrient Tracking Tool	The Nutrient Tracking Tool (NTT) compares agricultural management systems to calculate a change in nitrogen, phosphorous, sediment loss potential, and crop yield. GHG emissions evaluation to be incorporated in late 2017. http://nn.tarleton.edu/ntt/	AOI, soil type and characteristics, BMP type, fertilizer rate and source	Baseline and alternative conditions, reduction of Total N and P, % reduction and estimated crop yield	Field level scale, edge-of-field	University/ USDA ARS	Conservation Organizations, NGOs
Adapt-N	The Adapt-N tool provides precise nitrogen (N) fertilizer recommendations that account for the effects of seasonal conditions using high-resolution climate data, a dynamic computer model, and field-specific information on crop and soil management. http://www.adapt-n.com/	AOI, soil type and characteristics, drainage class and characteristics, tillage practices, organic matter content, fertilizer rate and source, cropping history and tillage practices	Nitrogen fertilizer recommendations based on input data	Field level scale	For-Profit/ University	NGOs, Farmers/ Operators
Fieldprint Calculator	The Fieldprint Platform is an assessment framework that empowers brands, retailers, suppliers and farmers at every stage in their sustainability journey, to measure the environmental impacts of commodity crop production and identify opportunities for continuous improvement. https://calculator.fieldtomarket.org/fieldprint-calculator/	AOI, soil type and characteristics, fertilizer rate and source, cropping history and tillage practices	sustainability indicators: Biodiversity, energy use, GHG emissions, irrigated water use, land use, soil carbon, soil conservation, water quality	Field level scale	NGO	Corporations, NGOs
STEPL	STEPL (Spreadsheet Tool for Estimating Pollutant Load is a customizable spreadsheet-based model for use in Excel. Using simple algorithms, it calculates nutrient and sediment loads from different land uses and the load reductions from the implementation of best management practices (BMPs). http://it.tetratech-ffx.com/steplweb/	AOI, climate history and information, livestock information, State and County, BMP practices and area applied	nitrogen, phosphorus, BOD and sediment loads with and without BMPs applied	Watershed level scale	For-Profit/ EPA	Conservation Organizations, NGOs
ACPF	The ACPF watershed planning toolbox is intended to leverage modern data sources and help local farming communities better address soil and water conservation needs. The ACPF toolbox can be used within the ArcGIS® environment to analyze soils, land use, and high-resolution topographic data to identify a broad range of opportunities to install conservation practices in fields and in watersheds. http://northcentralwater.org/acpf/	AOI, LiDAR data, soil type and characteristics, land use data, cropping history	Runoff risk assessment, controlled drainage opportunities, riparian analysis, nutrient removal wetlands opportunities, specific BMP implementation opportunities	Watershed and Field Level Scale	USDA ARS	Conservation Organizations, NGOs

Historical Cropping Data and Costs







References

1. *Illinois Nutrient Loss Reduction Strategy: Improving our water resources with collaboration and innovation*. (Illinois Environmental Protection Agency, Illinois Department of Agriculture, 2015).
2. Environmental Working Group Conservation Database. Available at: https://conservation.ewg.org/index.php. (Accessed: February 2017)
3. *Section 319 Biannual Report*. (Illinois Environmental Protection Agency, 2017).
4. CropScape - NASS CDL Program. Available at: https://nassgeodata.gmu.edu/CropScape/. (Accessed: 21st February 2017)
5. *Model Simulation of Soil Loss, Nutrient Loss, and Change in Soil Organic Carbon Associated with Crop Production*. (NRCS CEAP, 2006).
6. *Conservation Cropping Systems: An impactful long-term strategy for achieving Illinois' nutrient loss reduction strategy goals*. (American Farmland Trust, 2016).
7. Grains and Oilseeds Outlook for 2017. in *Agricultural Outlook Forum* (USDA).
8. *USDA Agricultural Projections to 2026*. (USDA, 2017).
9. *Water Pollution Control Loan Program: 2017 Intended Use Plan*. (Illinois EPA, 2016).
10. *Green Bonds Highlights 2016*. (Climate Bonds Initiative, 2017).
11. Kidney, S. Green Bonds Market Report: Water, water everywhere! US municipal green bonds issuance is dominated by water. *Climate Bonds Initiative* (2016). Available at: https://www.climatebonds.net/2016/04/gb-market-rpt-water-water-everywhere-cleveland-324m-saint-paul-77m-indiana-1158m-columbia. (Accessed: 17th February 2017)
12. Labelled Green Bonds Database. *Climate Bonds Initiative* Available at: https://www.climatebonds.net/cbi/pub/data/bonds. (Accessed: 17th February 2017)
13. *Coming Together to Protect Mississippi River Watersheds: Agriculture and Water Sector Collaboration for Nutrient Progress*. **25,** A2–A4 (US Water Alliance, 2014).
14. Rubin, K. *The Water Resources Utility of the Future: A Blueprint for Action*. (NACWA-WERF-WEF, 2013).
15. EPRI | Ohio River Basin Trading Project > Overview. Available at: http://wqt.epri.com/overview.html. (Accessed: 23rd February 2017)
16. Winrock International. Available at: https://www.winrock.org/project/running-off-pollution-paying-midwestern-farmers-to-improve-water-quality/. (Accessed: 23rd February 2017)
17. Adaptive management - Wisconsin DNR. Available at: http://dnr.wi.gov/topic/SurfaceWater/adaptivemanagement.html. (Accessed: 23rd February 2017)
18. Illinois Nutrient Loss Reduction Strategy Implementation. Available at: http://www.epa.illinois.gov/topics/water-quality/watershed-management/excess-nutrients/nutrient-loss-reduction-strategy/index.
19. 2017 Legislative Agenda. (2017).
20. DuPage River Salt Creek Workgroup Meeting Minutes. (2016).
21. *Global Responsibility Report*. (General Mills , 2016).
22. Green Lands Blue Waters. Available at: http://greenlandsbluewaters.net/.
23. Kernza® Grain & Perennial Agriculture | The Land Institute. *The Land Institute* Available at: https://landinstitute.org/our-work/perennial-crops/kernza/. (Accessed: 12th April 2017)
24. LONG ROOT ALE: A PARTNERSHIP BETWEEN PATAGONIA PROVISIONS AND HOPWORKS. Available at: http://hopworksbeer.com/2016/10/03/long-root-ale-a-partnership-between-patagonia-provisions-and-hopworks/.
25. Cascadian Farm invests in Kernza® perennial grain with promising restorative benefits for farms. Available at: https://www.generalmills.com/en/News/NewsReleases/Library/2017/March/kernza-3-7. (Accessed: 7th April 2017)
26. Arvegenix | crunchbase. Available at: https://www.crunchbase.com/organization/arvegenix#/entity. (Accessed: 7th April 2017)
27. USDA Blog » Consumer Demand Bolstering Organic Production and Markets in the U.S. Available at: http://blogs.usda.gov/2016/02/16/consumer-demand-bolstering-organic-production-and-markets-in-the-u-s/. (Accessed: 22nd February 2017)

28. Demand for Organic Food Growing Faster than Domestic Supply. Available at: https://www.organicconsumers.org/news/demand-organic-food-growing-faster-domestic-supply. (Accessed: 22nd February 2017)
29. *Oregon Food Infrastructure Gap Analysis: Where Could Investment Catalyze Regional Food System Growth and Development?* (Ecotrust, 2015).
30. Michigan Department of Agriculture & Rural Development. *MAEAP Phase 1 Powerpoint (2014)*. (Youtube, 2014).
31. Schultz, B. Incentives offered farmers to become Master Rice Growers. *LSU AgCenter* Available at: http://apps.lsuagcenter.com/news_archive/2012/june/headline_news/Incentives-offered-farmers-to-become-Master-Rice-Growers.htm. (Accessed: 5th March 2017)
32. Illinois Administrative Code- Illinois Rivers-Friendly Farmer Program Act.
33. World Resources Institute. Aqueduct: Measuring and Managing Water Risk. Available at: http://www.wri.org/our-work/project/aqueduct/. (Accessed: 22nd February 2017)
34. *Optimum Crop Productivity Ratings for Illinois Soil*. (University of Illinois at Urbana-Champaign, 2000).
35. Burras, C. L., Miller, G. A., Fenton, T. E. & Sassman, A. M. *Corn Suitability Rating 2 (CSR2) equation and component values*. (Illinois State Extension, 2015).
36. AcreValue. Available at: https://www.acrevalue.com/. (Accessed: 16th February 2017)
37. Soil Star Land Wellness Rating. Available at: https://www.soilstaraustralia.com/. (Accessed: 16th February 2017)
38. Caldecott, B., Howarth, N. & Mc Sharry, P. *Stranded Assets in Agriculture: Protecting Value from Environment-Related Risks*. (University of Oxford's Smith School of Enterprise and the Environment, 2013).
39. FY2016 Conservation Innovation Grants (CIG) National Awardees | NRCS. Available at: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/cig/?cid=nrcseprd1288325. (Accessed: 16th February 2017)
40. *2015 Illinois Land Values and Lease Trends*. (Illinois Society of Professional Farm Managers and Rural Appraisers, 2015).
41. Bernstein, B., Ruhf, K., Heleba, D. & Higby, A. *New England Farm Leasing Online Tutorial*. (Land for Good).
42. A New Lease on Farmland: Assuring a Future for Farming in the Northeast | Schumacher Center For New Economics. Available at: http://www.centerforneweconomics.org/publications/essays/witt/susan/a-new-lease-on-farmland. (Accessed: 20th February 2017)
43. O'Connor, C. *Soil matters: How the Federal Crop Insurance Program should be reformed to encourage low-risk farming methods with high-reward environmental outcomes*. 16 (Natural Resources Defense Council, 2013).
44. Fishermen and farmers discuss common interests over fantastic seafood. Available at: http://michaelfields.org/fishermen-and-farmers-discuss-common-interests-over-fantastic-seafood/. (Accessed: 22nd February 2017)

THE ROLE OF STATE AGENCIES IN THE ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY

NOVEMBER 2017

Part 2 of 3: Policy Briefs

These policy briefs outline the role of Illinois state agencies in advancing the Illinois Nutrient Loss Reduction Strategy (NLRS) and highlight opportunities to leverage resources to support its implementation.

This document is one part of a series of three documents created by Delta Institute to illuminate opportunities for various stakeholders to support NLRS implementation.

Contributors

Olga Lyandres, Sr. Program Specialist
Ryan Smith, Program Lead
David LeZaks, Program Lead
Ryan Anderson, Program Lead
Ben Shorofsky, Program Specialist
Amy Yanow, Communications Associate
Katie Yocum Musisi, Director of Communications and Development

About Delta Institute

Established in 1998, Delta Institute is a Chicago-based nonprofit organization that collaborates with communities to solve complex environmental challenges across the Midwest. Delta Institute works to achieve landscape-level impacts through its agriculture and water quality programs by working in partnership with farmers, agricultural retailers, local and national nonprofits, conservation districts, and state and federal partners.

Visit online at **www.delta-institute.org**.

Acknowledgements

This was produced with generous support from the Walton Family Foundation.

Helpful suggestions and discussion were provided by staff at American Farmland Trust, Illinois Environmental Council, Prairie Rivers Network, Illinois Stewardship Alliance, Bluestem Communications, Illinois Department of Agriculture, Illinois Environmental Protection Agency, and Illinois Department of Natural Resources.

Data Sources

Illinois Department of Agriculture
Illinois Environmental Protection Agency
Illinois Department of Natural Resources
United States Environmental Protection Agency
United States Department of Agriculture - National Agricultural Statistics Service
United States Department of Agriculture - Agricultural Research Service
Illinois Society of Professional Farm Managers and Rural Appraisers

REDUCING NUTRIENT LOSS IN ILLINOIS: REALIGNING THE STATE REVOLVING FUND PROGRAM

OPPORTUNITY

Illinois EPA's (IEPA) state revolving fund, the Water Pollution Control Loan Program (WPCLP), can support the achievement of statewide nutrient reduction goals by aligning project selection criteria with NLRS priorities. Funds that are already appropriated for the WPCLP should be directed to higher-impact projects by aligning prioritization criteria with the Illinois Nutrient Loss Reduction Strategy's (ILNLRS) priority watersheds and with agricultural conservation practices.

BACKGROUND

Created in 1989, the WPCLP appropriates about $400 million in low-interest assistance loans annually t**o help wastewater utilities and local governments finance the construction and maintenance of their water treatment infrastructure.** The WPCLP is funded with federal capitalization grants and a state match of 20 cents for every federal dollar, which grows and "revolves" with loan repayments and additional bonds. **Figure 1** shows the size and composition of the Fiscal Year (FY) 2018 fund, which will provide $500M in assistance.

A 2014 report from the US EPA Environmental Financial Advisory Board outlined opportunities for growing the capacity of the fund and using State Revolving Fund (SRF) funding for innovative pollution control approaches including green infrastructure and public-private partnerships. Expansion of the SRF and its use to address nonpoint source (NPS) pollution is applicable in rural communities where runoff comes from drainage areas include cropland rather than impervious surfaces.

As these discussions occur at the national level, **many states have modernized and expanded their SRF programs** (see Page 4 for examples). The State of Illinois is also seeking to expand and enhance the impact of the program and to meet the requirements of the Clean Water Act, as modified by the Water Resources Reform and Development Act of 2014 (WRRDA), which significantly expanded the list of project eligibility criteria for SRF financing.

Since the establishment of the Green Project Reserve in 2010, SRF expanded to support projects that implement green infrastructure, other NPS pollution control activities, water and energy efficiency improvements, and environmentally innovative activities. The most recent rule change affecting the Illinois WPCLP, taking effect in the state's FY18 loan portfolio, will enable private entities to apply for loans as well.

As shown in **Figure 2**, between 2011 and 2016, assistance fluctuated among facilities located in the NLRS priority watersheds, with most funding going to

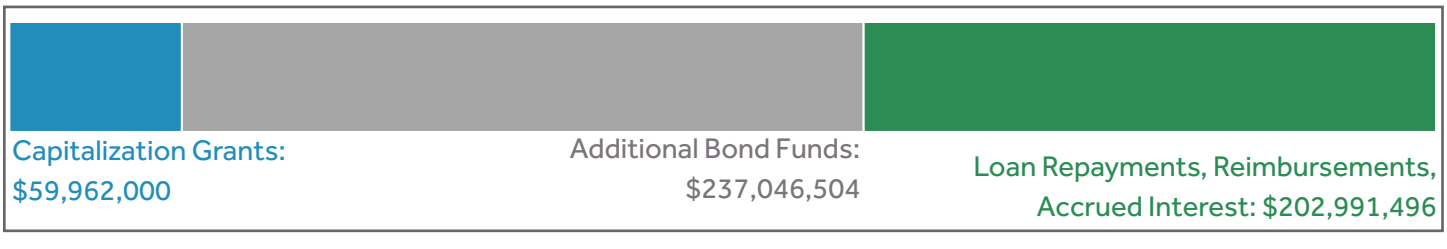


Figure 1. *Composition and amount of the State Fiscal Year 2018 Water Pollution Control Loan Program fund, totaling $500M.*

the northeast area of the state. Facilities in the Des Plaines watershed receive approximately half of the total assistance from WPCLP. The remaining 9 priority watersheds combined only received up to 15% of the assistance. The remainder went to 40 other watersheds in the state.

With the approval of the loan rules outlined in Title 35 Section 365 of the Illinois Administrative Code (IAC), FY18 **WPCLP will expand the list of project eligibility criteria for the WPCLP financing significantly, including private entities such as agricultural producers** (35 IAC 365.130).

Other states that have utilized the SRF programs to provide financing to farmers (see sidebar for more information about Iowa's program), selected a suite of engineered structural practices as eligible practices. Similarly, Illinois' WPCLP guidance can begin by encouraging applications looking to implement structural conservation practices, in particular those that are also prioritized by the NLRS such as bioreactors and wetlands. County conservation Districts can work with farmers to identify projects that are eligible and facilitate the application process to Illinois EPA.

A specific focus of the expansion of eligible activities with WPCLP will be to provide funding to stormwater projects that provide a water quality benefit. The new rules establish 11 eligible categories of projects and activities, including development and implementation of watershed projects.

As outlined in section 35 IAC 365.210(d), **Illinois will offer an Environmental Impact Discount (EID) on the loan agreement interest rate.** The EID would apply when at least 50% of the eligible project costs fund nutrient removal/reduction activities. The applicant, in turn, receives a 0.2% discount on the interest rate of their loan.

Finally, efforts to amend and update the loan rules in part 35 IAC 366 that set criteria to prioritize projects are also currently underway. These rules were last updated in 1996 and take into account factors such as financial impact, water quality, organic load, assessment of the existing facility, and operational excellence of the facility. **The current prioritization rules, when evaluating water quality, elevate projects in waterways that are already high quality, resulting in shifting resources away from streams and lakes that are impaired.**

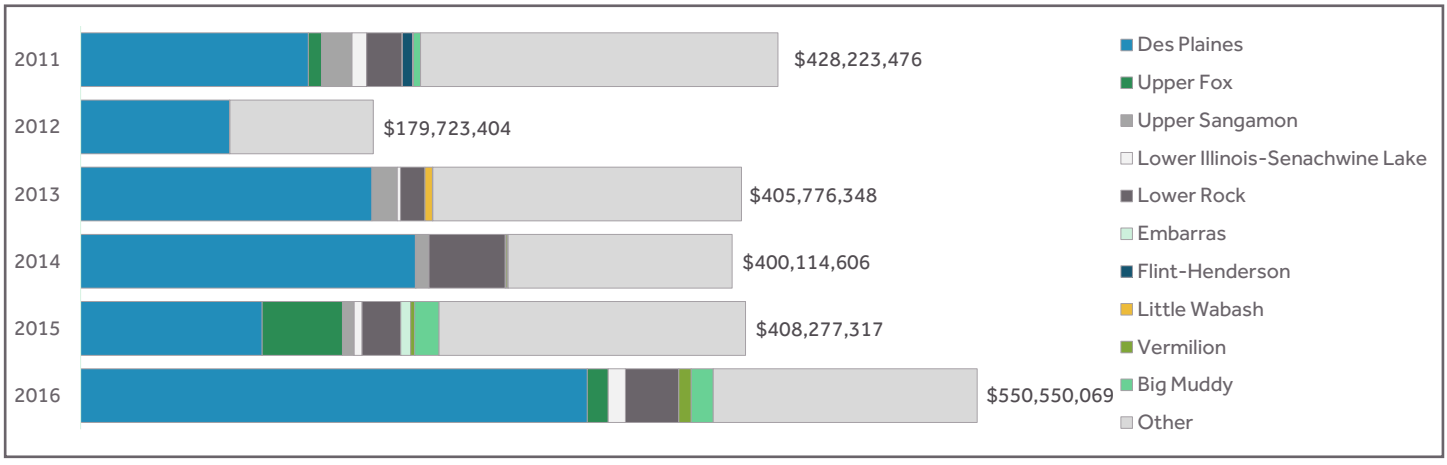


Figure 2. *WPCLP assistance provided to facilities in Illinois for years 2011-2016. Assistance to NLRS priority watersheds is highlighted.*

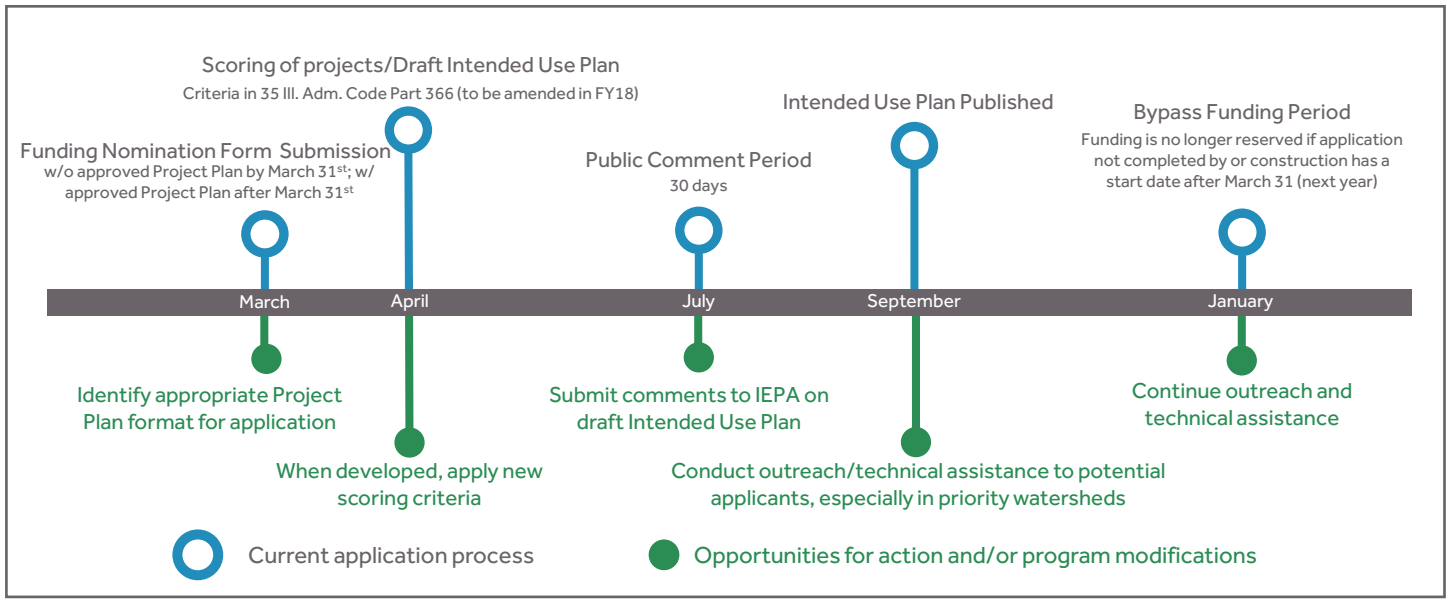


Figure 3. *Current WPCLP application process and potential program modifications and actions that support utilization of the program for agricultural projects.*

RECOMMENDED ACTIONS

The IEPA should inform agricultural producers about the WPCLP program, amend the application process, and develop guidance for new types of applicants and project types. The current application process and opportunities for process improvement are outlined in **Figure 3**. IEPA, as the agency administering the program, is responsible for implementing program changes with input from stakeholders. Community partners can assist IEPA with conducting outreach to newly eligible applicants.

Result: *Producers will be able to use this opportunity to finance agricultural conservation practices.*

The IEPA should use the EID to evaluate project performance in reducing nitrogen and/or phosphorus, especially with nonpoint source-focused project elements. The EID offers a reduced loan interest rate if performance is demonstrated. IEPA can utilize this aspect of the program to set up a tiered discount for different reduction levels, essentially creating a pay-for-performance framework within the WPCLP program.

Result*: Performance-based conservation approach will be incentivized*

The IEPA should seek to align the new loan ranking framework with the priorities already identified in the NLRS. IEPA is currently developing a new framework for prioritizing loan applications. Among the many different scoring criteria being developed in the new rules, there are plans to award points for projects which: a) result in a reduction in phosphorous and/ or nitrogen in the receiving water body, b) implement agricultural conservation practices, c) address elements from a watershed plan, d) implement green infrastructure or agricultural conservation practices, or e) incorporate activities that are part of an approved TMDL. The development of new prioritization rules is currently underway with opportunities for stakeholder engagement in the summer and fall of 2017.

NLRS priority watersheds could be ranked higher, with special emphasis on point source-dominated watersheds, including the Upper Fox, Des Plaines, and Upper Sangamon Rivers. Furthermore, applications featuring conservation practices highlighted by NLRS

should also be elevated in the ranking.

These watersheds and conservation practices are outlined in Delta Institute's Market Drivers Overview Whitepaper. As IEPA develops the rules package, agricultural and conservation organizations should engage in the process to provide feedback and ensure that NLRS priorities are included in the WPCLP rankings.

Result: *Dedicated financial support for NLRS implementation projects will be available, especially for projects in areas of most need.*

The IEPA should evaluate the historical distribution of their loans and identify barriers to program access. It is important to understand the historical funding trends and why program funding is underutilized by some communities across the state. Once the analysis is completed, the IEPA should prioritize funding to small and economically disadvantaged communities, of which there are many in high priority watersheds.

Result: *Funds will be more equitably distributed to areas of need throughout the state.*

CONNECTION TO OTHER MARKET DRIVERS

WCPLP uses State Match Bonds and additional bonds to generate revenue for the fund – the state could incorporate green bonds to direct funding to environmentally impactful projects.

The pay-for-performance approach (discussed in more detail in Delta Institute's Market Drivers Overview Whitepaper and in the accompanying brief is intended to link conservation practices to environmental outcomes. The WPCLP serves as a funding pool in a pay-for-performance program that involves partnerships between point sources (typical recipients of SRF assistance) and agricultural producers. Alternatively, rather in payments for pollution reduced, the SRF can offer a discount in expenses for demonstrating performance. For example, reduced loan interest rates – see discussion in the **Recommended Actions** section.

EXAMPLES

Iowa's Livestock Water Quality Program and Local Water Protection Program direct dollars to agricultural conservation practices provide in the range of $5 to $12 million per year. These programs are administered by the Department of Agriculture and rely on partnerships with local Soil and Water Conservation Districts (SWCDs) to work with landowners and select eligible projects and a network of private lenders. The programs also identify a short list of practices that are eligible, effectively prioritizing particular practices for implementation. Iowa also has a Sponsored Project Program where some portion of the interest repayment amount is invested into watershed projects. This can serve as a model for a pay-for-performance fund for implementation of conservation projects.

ABOUT DELTA INSTITUTE

For more information on how you can work with us, visit us online at www.delta-institute.org or contact Olga Lyandres, olyandres@delta-institute.org, 312-651-4349.

REDUCING NUTRIENT LOSS IN ILLINOIS: UTILIZING THE PAY-FOR-PERFORMANCE APPROACH

OPPORTUNITY

A Pay-for-Performance (PfP) approach can link the implementation of conservation systems to environmental outcomes, achieving measurable reductions with limited funds. Compared to conventional practice-based cost share programs, an approach that ties financial incentives to verifiable pollution reductions has greater potential to meet the long-term goals of the NLRS at lower cost and in less time.

BACKGROUND

The federal Clean Water Act (CWA) of 1972 gave US EPA the authority to implement pollution control programs for private industry and public utilities. **While the CWA regulates activities from point source pollution, it has no explicit authority for nonpoint source pollution control,** including any agricultural operations that do not require a CWA discharge permit.

Furthermore, through CWA, states are required to report assessment and impairment information for all waters within their jurisdiction every two years. These reports provide essential details about the condition, designated uses, causes of impairment, and probable sources for all waterbodies. Any waterway that is not adequately clean for its designated use (e.g. recreation, drinking water, fishing) is deemed impaired and listed on EPA's 303(d) list. To address the impairments, the state develops a Total Maximum Daily Load (TMDL), a maximum daily amount of a specific pollutant that a waterway can assimilate without violating state water quality standards. **While the TMDL program focused initially on point source pollution,** the focus has broadened to include nonpoint source pollution, such as nutrient and sediment runoff from agricultural land.

To address agricultural sources of pollution, federal and state agencies have offered voluntary conservation programs that provide both technical and financial assistance to landowners and farmers to implement conservation practices to reduce environmental impact. These conservation programs are **pay-for practice programs**, which assign monetary rates to specific practices that meet standards set by the United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS), but they fail to track conservation outcomes.

Pay-for-Performance (PfP) conservation is a new approach that provides flexible conservation options to farmers while delivering quantifiable water quality benefits in agricultural watersheds. By tying a payment structure to a specific pollutant (e.g. nitrogen, phosphorus, sediment) and paying a farmer for pollutant reductions, PfP conservation programs maximize the cost effectiveness of conservation dollars and achieve measurable improvements.

PfP can be designed to incentivize conservation through a funding structure that uses federal or state grants, or public or private foundations' funding. PfP programs can also involve industrial or municipal point source facilities, either as a collaborative partnership or as a **Water Quality Credit Trading (WQCT) framework, wherein point source facilities can buy nutrient credits from farmers who implement conservation practices to assist in meeting IEPA regulatory requirements.**

As the NLRS was developed, the science assessment was conducted to identify the priority watersheds, taking the following into consideration: total loading

UTILIZING THE PAY-FOR-PERFORMANCE APPROACH (CONT.)

of phosphorus/nitrogen, local water quality conditions, and existing watershed management plans. For a PfP program to be successful, additional factors to consider include: the availability of point source discharge data, impairment status, and impairment source.

Of the priority watersheds identified in the NLRS, the following show the most potential for a PfP program: Big Muddy, Lower Illinois, Upper Sangamon, and Vermilion (tributary to the Illinois River), as shown in Figure 1. Their geography (within state boundaries), mix of point and nonpoint source loads, and hydrology (the headwaters of a river system) combine to make them good candidates for exploring a PfP framework. Within each of the watersheds, there are at least two municipal water treatment plants that have significant upstream agricultural acreage which would provide an opportunity for partnership in a PfP framework.

The Vermilion River watershed, draining to the Illinois River, should be considered for a pilot program due to its geography, hydrology, as well as an active mechanism to drive implementation (an impairment designation and a corresponding Total Maximum Daily Load) and ongoing conservation projects and partnerships among local stakeholders. In addition, the majority of the watershed lies within Livingston County, significantly reducing complexity in collaborative projects involving nontraditional partners, such as permitted facilities and agricultural producers. The Vermilion River also contains waterways designated as a public

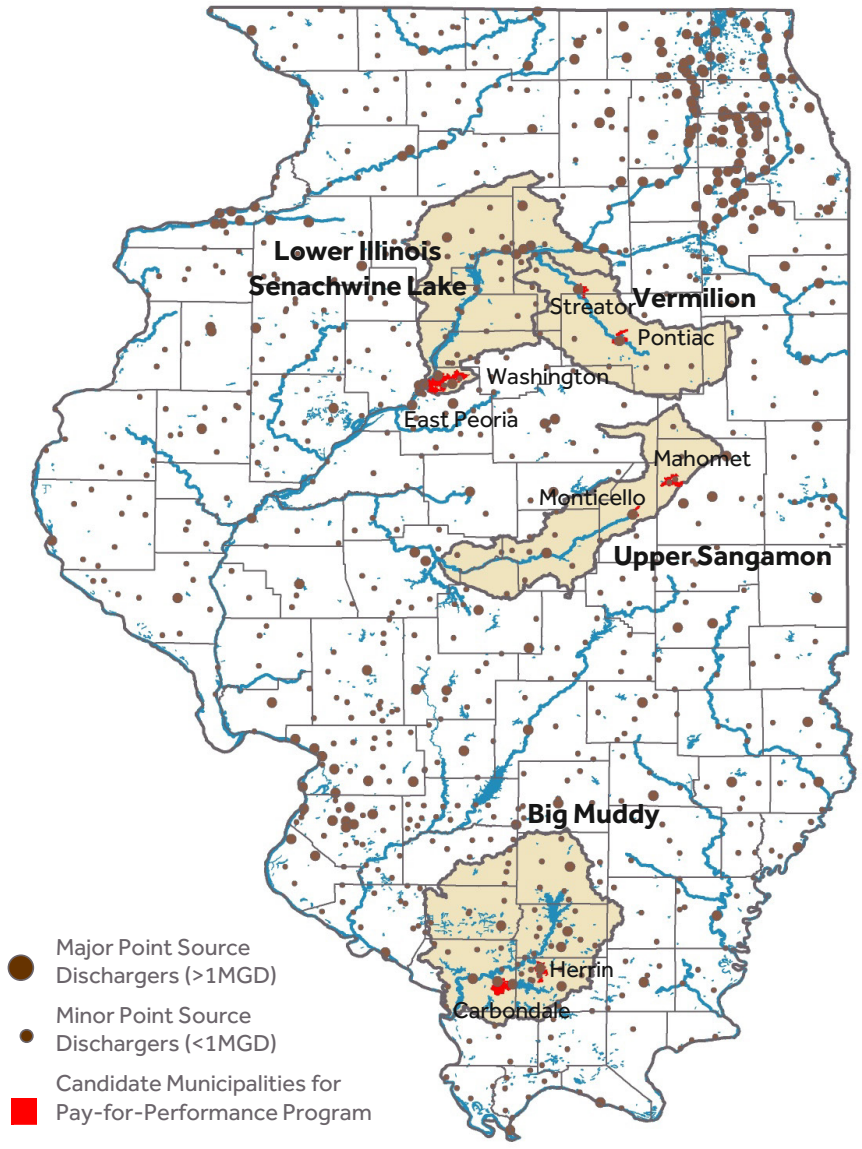


Figure 1. *Potential watersheds for a PfP approach in Illinois. At least 2 municipalities with major wastewater treatment plants are identified within each watershed..*

water supply source, further elevating the need to take action and address water quality impairments.

The Vermilion watershed is shown in **Figure 2** in more detail, including the two municipalities, Streator and Pontiac, on the main stem of the river, and the major wastewater treatment facilities that discharge effluent to the river. As shown in the map, the majority of crops in the watershed are corn and soybeans, which is representative of cropland in Illinois. The map shows where existing US Geological Survey gauges are located and highlights the lack of water quality and flow data throughout the watershed downstream.If monitoring can occur at or near the wastewater treatment facilities and before the Vermilion flows in the Illinois River, it would allow tracking and verification of conservation performance and resulting nutrient reductions.

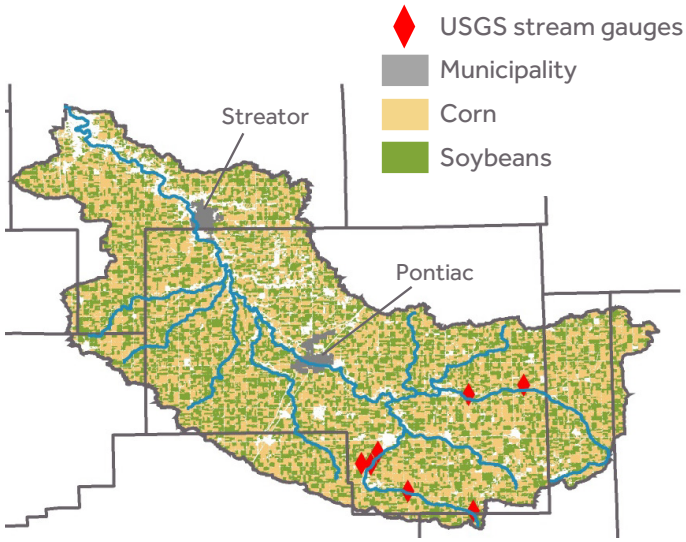


Figure 2. *Vermilion River watershed as PfP program pilot candidate. Streator and Pontiac's wastewater treatment plants' locations on the main stem are well-positioned to participate in a PfP program. One identified barrier is lack of water quality data and monitoring infrastructure in the lower part of the watershed.*

RECOMMENDED ACTIONS

Focus PfP program development in NLRS priority watersheds and/or impaired watersheds as assessed by IEPA. Studies and scientific assessments have been conducted in a number of these watersheds and have indicated that an impairment exists. Illinois DOA should work with County SWCDs to identify existing and/or develop PfP based programs within these watersheds to improve environmental outcomes. As described above, a pilot PfP program can be implemented in the Vermilion watershed.

Result: *Reduction of sediment and nutrient loading is maximized in priority watersheds.*

Work with USGS, agricultural organizations, and local communities to identify and establish appropriate locations for in-stream monitoring. The Illinois Nutrient Research & Education Council provides financial support for nutrient research and has the network to assist in sponsoring technology innovation for real-time and low-cost monitoring. A key to making PfP successful is the availability of models and monitoring infrastructure in the program's watershed. In addition to already installed super gages used to track nutrient loadings from Illinois major rivers, the Nutrient Monitoring Council (an NLRS working group) should install additional gages at outlets of other major

Result: *The appropriate infrastructure is in place to assess and verify nutrient reductions at a watershed scale.*

Enforce timely monitoring and reporting of facility discharges of nutrients into waterways. Of the 217 major municipal dischargers in Illinois, only 164 facilities monitor phosphorus, and 152 facilities monitor nitrate-nitrogen. Of those, only 67 have effluent limits for phosphorus and 13 for nitrate-nitrogen. Without consistent monitoring, the point source loads and reduction demand cannot be evaluated. The NLRS

UTILIZING THE PAY-FOR-PERFORMANCE APPROACH (CONT.)

Biennial report released in August 2017, indicates that 122 facilities now have phosphorus limits in their permits. Yet, it does not attempt to quantify changes in nutrient loading from point sources because the most basic information about discharges is not systematically available. While facilities are conducting their optimization and feasibility studies, IEPA should require monitoring and reporting from all facilities.

Result: *Accurate trends and reduction targets for point sources can be established.*

Redesign state agency programs to serve as a conduit between agricultural nonpoint sources and municipal point sources. The multi-agency Partners for Conservation program can be restructured as a catalyst for PfP initiatives although funding for the program has been inconsistent or absent. State budgetary uncertainties will continue to make it an unreliable source of implementation funding. The IEPA impaired waters assessment and TMDL methodology can also be modified in time for the release of the 2018 Integrated Water Quality Report to address impairments in a more holistic, watershed based approach conducive to PfP programs.

Result: *Farmers and point sources work together to meet water quality standards.*

ABOUT DELTA INSTITUTE

For more information on how you can work with us, visit us online at www.delta-institute.org or contact Olga Lyandres, olyandres@delta-institute.org, 312-651-4349.

CONNECTION TO OTHER MARKET DRIVERS

PfP structure and resulting collaboration between point sources, farmers, and other entities can be utilized as a basis for forming novel governance frameworks for financing and implementing watershed protection projects such as the Environmental Utility, discussed in more detail in the Delta Institute's Market Drivers Overview Whitepaper. One of the funding pools that's accessible to point sources is the Illinois' state revolving fund, the Water Pollution Control Loan Program, discussed in more detail in a separate brief.

EXAMPLES

Recent PfP projects in the Saginaw Bay watershed in Michigan and the Milwaukee River watershed in Wisconsin were structured to incentivize farmers' reduction of sediment and phosphorus loading, respectively. The programs are administered by Non Government Organizations (NGOs) and rely on partnerships with local organizations, such as the Soil and Water Conservation Districts, to provide technical assistance to farmers as well as verification of the conservation practices. The programs leverage geography-specific quantification models that have the ability to identify areas at high risk for sediment and nutrient runoff. These results assist the project field staff in targeting outreach efforts to where the greatest potential for cost-effective reductions can be expected.

REDUCING NUTRIENT LOSS IN ILLINOIS: LAND TENURE AND LONG-TERM CONSERVATION

OPPORTUNITY

Enhancing land tenure security can help to incentivize long-term conservation on leased land, both private and public. Specifically, Illinois state agencies can use the leased land they own to promote stewardship objectives and help Illinois reach its nutrient loss reduction goals.

BACKGROUND

Secure land tenure is one of the key factors that influences conservation behavior. According to the 2012 Census of Agriculture, Illinois ranks among the top states in share of cropland leased at 60%. In some counties the proportion of leased agricultural land exceeds 80%, as shown in **Figure 1**. In addition to managing the majority of cropland acres in the state, tenants farm 521 acres on average, compared to 159 acres for owner-operators.

According to the 2016 Illinois Society of Professional Farm Managers and Rural Appraisers report, a typical lease term is one year. While the vast majority of these leases are from private landowners, the state also owns and manages land rented by tenants for farming. **The Department of Natural Resources (DNR) has the largest land footprint of state agencies, averaging 35,000 acres over the last 5 years.** By comparison, the Department of Agriculture leases approximately 1,000 acres of cropland. Most DNR leases have 4-year terms, but farms participating in the federal Conservation Reserve Program can extend to 15 years. DNR leases are subject to open and competitive bidding, with some exceptions, as specified by Section 150.20 of the Illinois Administrative Code.

Across the state, rental rates vary depending on the productivity of the land. 2016 rental rates in Illinois ranged from $75 to $425 per acre, with regional averages shown in **Figure 2**. By contrast, average lease rates for DNR farmland ranged from $98 to $117 per acre between 2013 and 2017. The leases generated approximately $4 million for the state in 2016 alone, while leasing the same land at typical market rates could have increased the total to $7.6 million.

Though public land leased for farming comprises a small portion of all rented cropland acres, the state can use its leased land to showcase leadership and innovation in land stewardship. Specifically, state managed leases could be tied directly to implementing the recommendations of the NLRS.

RECOMMENDED ACTIONS

IDNR should coordinate leasing activities on public land with other state agencies that own and lease farmland, and develop better policies that enhance tenure security (e.g. longer lease terms, crop share arrangements) that make it worthwhile to invest in long term conservation practices on private land.

Result: *Farmland leasing activities on public lands across the state are managed through a task force or committee to coordinate and enhance conservation on public land. The designated entity also evaluates and recommends strategies to enhance land tenure security on privately leased land.*

Agencies that rent public land for farming, led by Department of Natural Resources, should amend leasing practices for farmland to promote land stewardship. The modifications can include

LAND TENURE AND LONG-TERM CONSERVATION (CONT.)

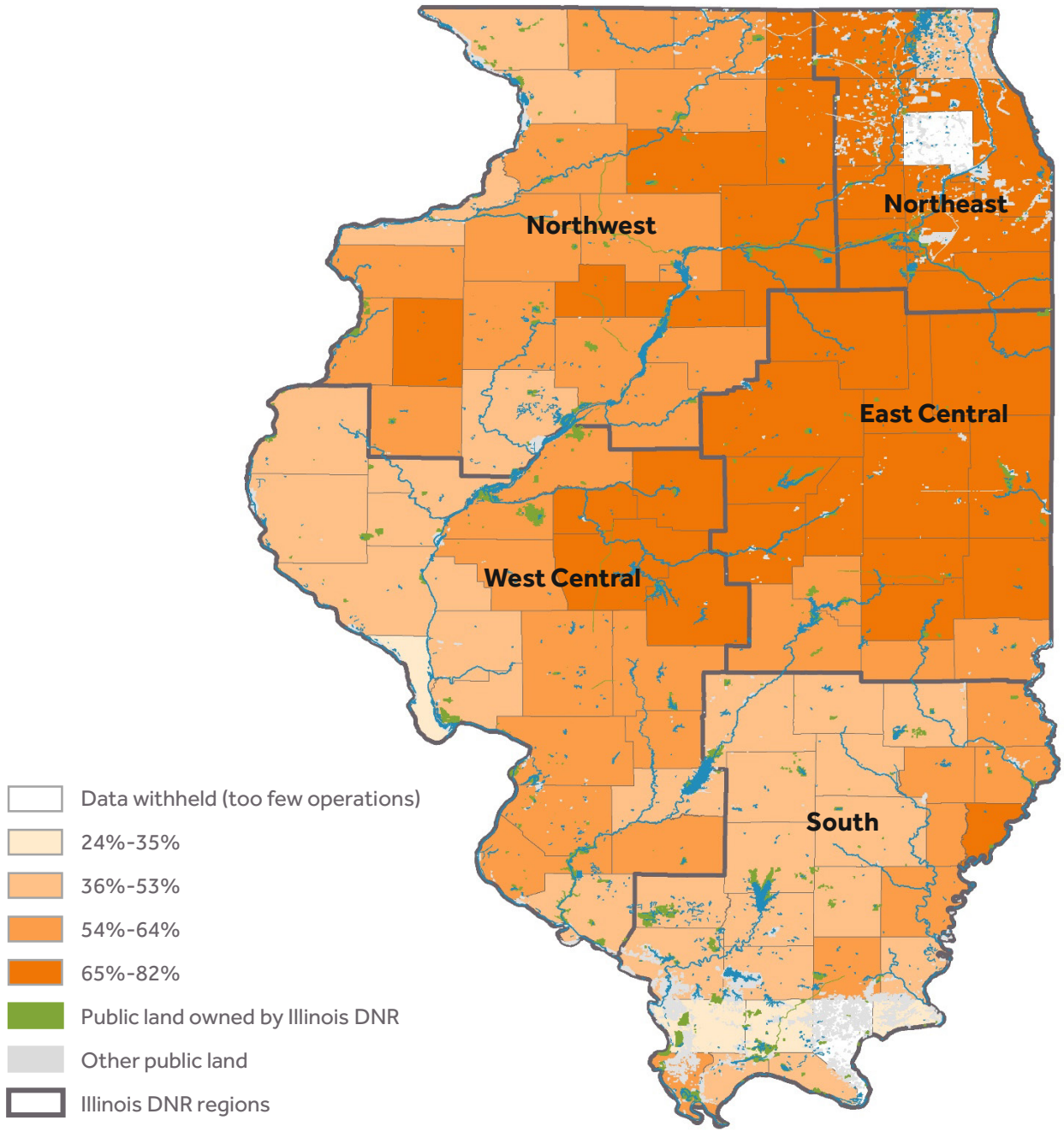


Figure 1. *Proportion of leased acres in Illinois by county.Public lands (managed by local, state, and federal agencies are also shown). Illinois Department of Natural Resources leases approximately 35,000 acres of its land for farming. Data: USDA NASS, 2012 Census of Agriculture.*

LAND TENURE AND LONG-TERM CONSERVATION (CONT.)

conservation standards on state-owned land, aligned with practices that are prioritized in the NLRS. Other changes include longer lease terms that provide more security for the tenants and reduce the risk in adopting practices such as cover crops, which may take up to 5 years to demonstrate benefits.

Result: *State administrative rules for leasing reflect agency and NLRS conservation priorities by allowing longer leases and incentivizing practices prioritized in the NLRS (e.g. reduced tillage, cover crops, improved nutrient management).*

Use state - leased land to create a network of demonstration sites that train producers and offer equipment rental discounts to support practice implementation.

Result: *Farmers receive the technical resources needed to implement practices without the financial risk associated with buying new equipment.*

Encourage diversified crop rotations by offering market guarantees for "new" crops. Cropping systems that support long-term resilience and soil health include diversified crop rotations, which are risky for producers who have short-term leases.

Result: *Risk is reduced for farmers that introduce new crops into their rotations.*

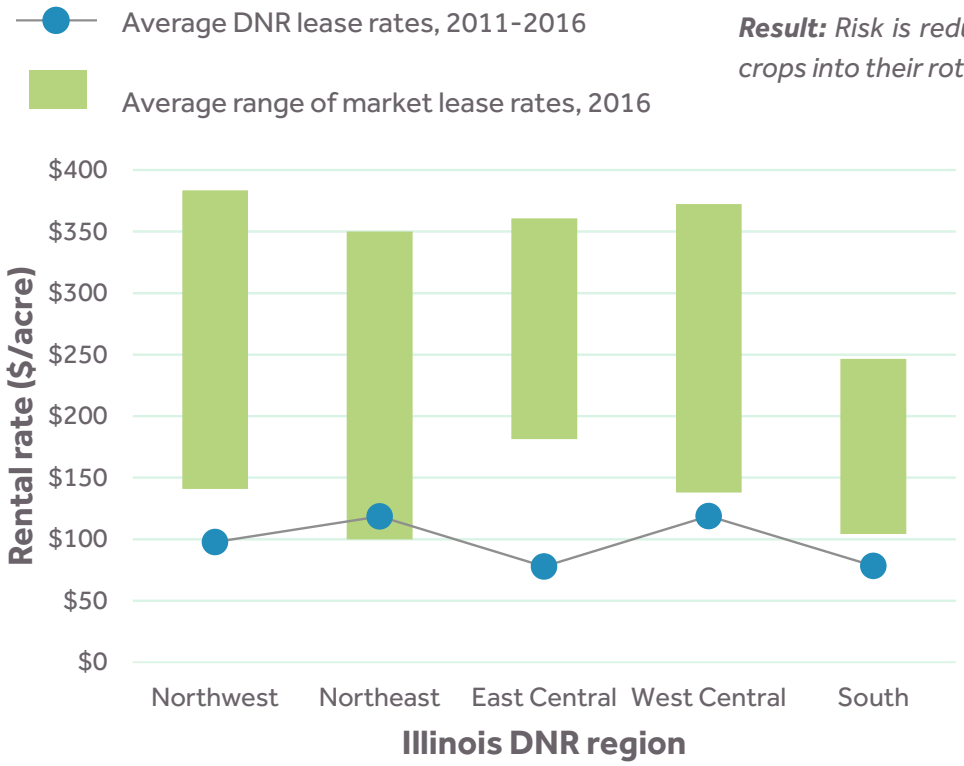


Figure 2. *Lease rates range across Illinois depending on location and productivity of the land. Average rates garnered by DNR typically fall below market rates.*

ABOUT DELTA INSTITUTE

For more information on how you can work with us, visit us online at www.delta-institute.org or contact Olga Lyandres, olyandres@delta-institute.org, 312-651-4349.

CONNECTION TO OTHER MARKET DRIVERS

Increasing lease length and securing land tenure for farmers can in turn lead to implementation of conservation practices that improve soil health and fertility, while reducing input costs and nutrient runoff.

Management decisions that improve soil health also have the potential to increase the value of the land, which is discussed in more detail in the Delta Institute's Market Drivers Overview Whitepaper.


Photo credit: John Wepking

GETTING DOWN TO THE ROOTS: A SOIL CARBON STRATEGY FOR ILLINOIS

DECEMBER 2017

Part 3 of 3: Soil Carbon Strategy

This document identifies opportunities for broader communication and programmatic alignment within the agricultural section to move toward a recarbonized rural landscape that provides water quality, climate, and community benefits.

This document is one part of a series of three documents created by Delta Institute to illuminate opportunities for various stakeholders to support NLRS implementation.

delta institute

Contributors

Olga Lyandres, Sr. Program Specialist
Ryan Smith, Program Lead
David LeZaks, Program Lead
Ryan Anderson, Program Lead
Amy Yanow, Communications Associate
Katie Yocum Musisi, Director of Communications and Development

About Delta Institute

Established in 1998, Delta Institute is a Chicago-based nonprofit organization that collaborates with communities to solve complex environmental challenges across the Midwest. Delta Institute works to achieve landscape-level impacts through its agriculture and water quality programs by working in partnership with farmers, agricultural retailers, local and national nonprofits, conservation districts, and state and federal partners.
Visit online at www.delta-institute.org.

Acknowledgements

This was produced with generous support from the Walton Family Foundation.

TABLE OF CONTENTS

SETTING THE STAGE

Even with significant investment of time and resources into reducing nutrient losses from Illinois, limited progress has been made in the last decade. The dominant modes of agricultural production in Illinois over the past century have resulted in significant losses of soil, and the ancillary benefits that soils provide. The carbon contained within the soil organic matter is not only crucial for its role of keeping greenhouse gases from entering the atmosphere, but also for its role in cultivating crops, mediating water quality and infiltration, nutrient cycling, and pest moderation.

Building on Delta's recent work examining market drivers for implementation of the Illinois Nutrient Loss Reduction Strategy (NLRS),[1,2] this strategy report focuses on identifying opportunities and areas for broader communication and programmatic emphasis to move toward a recarbonized rural landscape that provides water quality, climate, and community benefits. Incorporating other important thought leadership in this area (see Appendix for list of relevant reports and studies), this framework presents opportunities to recouple carbon and nutrient cycles, along with strategies that could be used to further engage the agricultural community. Currently there is significant interest in soil health and understanding and harnessing soil's biological properties and growing interest from across the agricultural sector. Though restoring soil health presents an remarkable opportunity, production practices, quantitative tools, conservation programs, and investment models need to be developed and linked in order to truly regenerate soils in Illinois, across the Midwest, and nationally, We present a synthesis of research and current initiatives that provides the basis for such alignment between practices, policies, and investments for shifting agricultural systems. Our recommendations focus on:

- Prioritizing practices with high reduction potential for carbon, nitrogen, and phosphorus;
- Developing alternative financing structures and policies that incentivize adoption.

Focus on soil health

In 2014, the USDA Natural Resources Conservation Service (NRCS) formed a Soil Health Division to "incentivize and facilitate producers in implementing science-based, effective, economically viable soil health management systems on the nation's diverse agricultural lands" through partnerships.[3] The NRCS initiative, building on decades of research and practice, recommends that producers can manage for soil health by incorporating the following four principles into their systems:[4]

- Manage more by disturbing soil less;
- Diversify soil biota with plant diversity;
- Keep a living root growing throughout the year; and
- Keep the soil covered as much as possible

Taken together, these cropping practices make up the foundation of what is commonly referred to as carbon farming.[5] In grazed systems, there is a set of practices that mimics the movement of native herbivores that also acts to invigorate the soil. These healthy soil approaches for crops and livestock can also be integrated, such as in the grazing of cover crops. Globally, there is a growing focus on restoring soil health as the basis for food production and storage for water and carbon.

Carbon stocks and the potential for sequestration

Loss of carbon associated with agricultural land use is documented and highlights the opportunity for working lands to re-capture the carbon. A 2017 study evaluated the effect of 12,000 years of

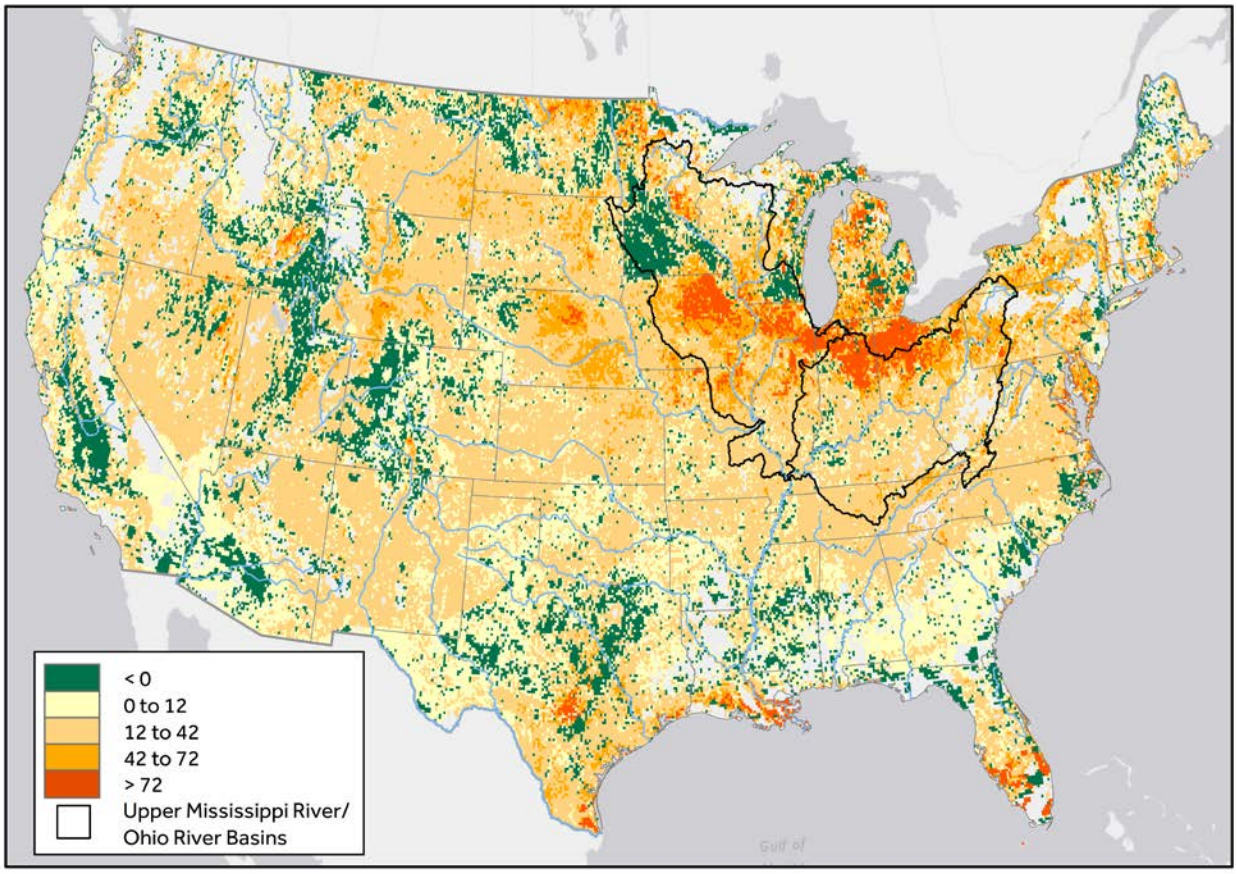


Figure 1. Change in SOC Stocks (0-200 cm), Presettlement to 2010. Adapted from Sanderman et al. 2017.

agricultural land use on soil organic carbon (SOC) stocks globally and estimated a net loss of 133 billion metric tons, or roughly one-third of global fossil fuel emissions since the Industrial Revolution.[6] In the US, the areas that exhibit the highest losses are primarily in the Midwest, including Illinois, Iowa, Indiana, and Ohio, where conventional row crop systems dominate (**Figure 1**). Since this is where the most depletion has occurred, most of the carbon sequestration potential associated with land management changes lies in the Midwest as well.

Taking a closer look at Illinois, the map in **Figure 2** shows estimated carbon losses within two meters of the surface. Average losses of 42 metric tons of carbon per hectare, or 62 metric tons of carbon dioxide-equivalent (MT CO_2e) per acre, suggest significant storage potential. However, it is important to keep in mind that the sequestration potential is not uniform across the state. With this dataset, location-specific carbon storage potentials can be determined for specific areas within Illinois and other states in the Upper Mississippi River Basin. **Figure 2** also includes 7 paired measurement sites referenced in the study, which compare SOC stocks between native prairie and a corn-soybean rotation after decades of conventional tillage. Within the topsoil layer, or 0-30 cm depth, the difference between native prairie and cropland soil carbon ranged from 41 to 98 MT CO_2e per acre.

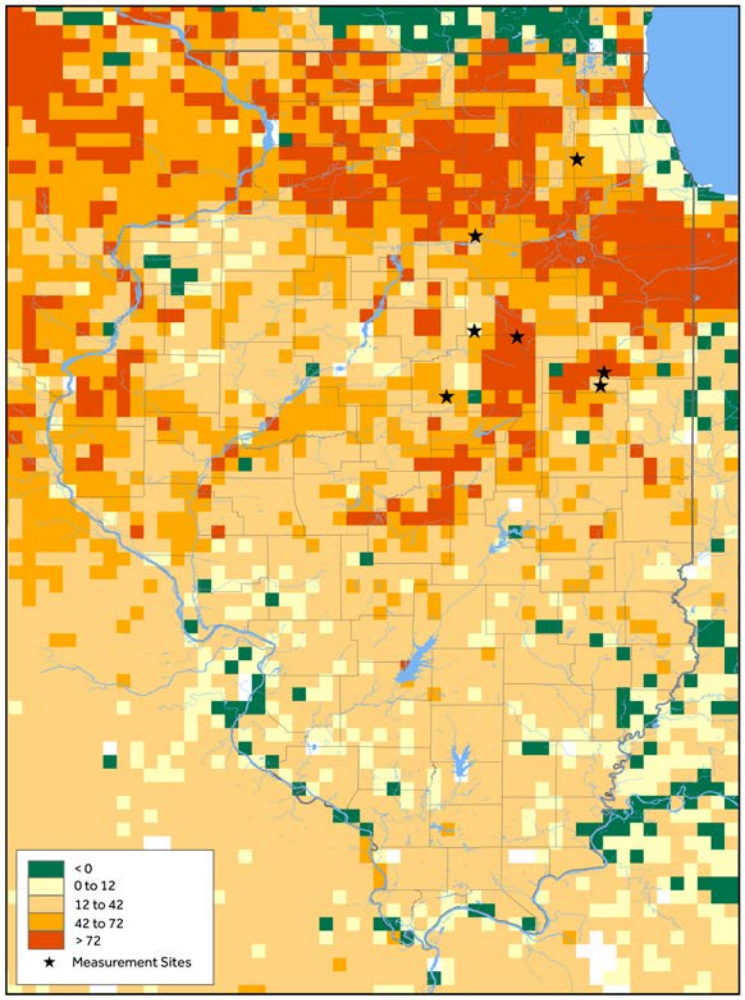


Figure 2. Change in SOC Stocks (0-200 cm), Presettlement to 2010 in Illinois. Adapted from Sanderman et al. 2017. The NLRS priority watersheds can be found in the Appendix.

The challenge now is to identify how much carbon can be restored and through which practices, particularly those that align with the NRCS soil health strategy as well as the Illinois NLRS, which is among the key drivers for implementing conservation in the state. Farmers in Illinois can play an important role in regenerating their soils by adopting practices such as no-till, cover crops, and adding a small grain, especially when used together as a conservation cropping system. As we will show, combining these soil-building practices can return SOC stocks to presettlement levels without converting Illinois cropland back to native vegetation.

Given that cropland has the potential to store carbon in the soil, we can make meaningful strides in rebuilding soil health and water quality by changing how the land is managed and the types of conservation practices that are implemented. The degree to which these opportunities can be utilized depends on combining the technical knowledge about the practices, as well as the right

incentives and policies to shift away from current paradigm and toward a more regenerative agriculture system. In the next section, we will examine the conservation practices already listed in the Illinois NLRS, evaluate them based on their carbon storage and nutrient loss reduction potentials and identify approaches for better alignment between the NLRS and soil carbon restoration goals.

PRIORITIZING PRACTICES WITH NUTRIENT AND CARBON BENEFITS

Overview of nutrient reduction and carbon sequestration potentials by practice

Below, we identify the agricultural practices that are impactful beyond nutrient loss and can provide a broader suite of soil health and climate benefits from rural landscapes. In addition to the practices outlined in the Illinois NLRS, we evaluated practices highlighted by American Farmland Trust's report on Conservation Cropping Systems[7] and NRCS practices included in Carbon and Greenhouse Gas Evaluation for NRCS Conservation Practice Planning (COMET-Planner). COMET-Planner is part of USDA's suite of tools to evaluate carbon and other greenhouse gas fluxes.[8] COMET-Planner provides county level estimates of carbon dioxide, nitrous oxide, and methane emissions and sinks. Given a rate of reduction and a reasonable scale at which a practice could be deployed, each practice is ranked by its nutrient loss reduction (N and P, as data availability allows) and carbon sequestration potential. The individual rankings were then combined for a nutrient/carbon ranking. For each practices, we also estimated implementation costs. All source data, assumptions, and quantitative estimates used in **Table 1** can be found in the Appendix.

In our analysis of the soil carbon sequestration potential of practices, a few practices emerge as cost-effective strategies for reducing nutrient losses and sequestering carbon. Of the 36 practices or scenarios analyzed, five ranked highly across both nutrient and carbon reduction potentials. Within the NLRS practices, the cover crop scenarios that encompass all corn and soybean acres ranked highest, mainly because of the large area of agricultural land that they cover (0.32 MT CO_2e per acre per year). Currently, cover crops are planted on just 1.4% of Illinois annual cropland.[9]

Other practices, such as installing a riparian forest buffer ranked lower overall due to smaller potential acreage, but can sequester carbon at a higher rate (2.2 MT CO_2e per acre per year). Some practices have significant nutrient reductions, but little carbon sequestration potential. Others have great potential for both, but have barriers to large scale implementation. Notably, while the N rate or application adjustment practices in the NLRS are important tools for nutrient loss reduction, they have insignificant impacts on soil carbon. Alternatively, Nutrient Management – Replacing Synthetic Nitrogen Fertilizer with Soil Amendments (part of NRCS Conservation Practice Standard 590) ranks highly across nutrient loss reduction and carbon sequestration, and given the number of acres that could use this practice, it could be a significant contributor to addressing carbon and nutrient loss challenges. The major impediment to scaling this practice is the lack of available soil amendments, whether derived from animal waste, human waste, pre/post-consumer food waste, or landscaping materials. This gap presents an opportunity for investment and innovation in the sector. An example

of a program, currently at pilot scale, is described in **Panel 1**. To implement wide-scale composting initiatives, there is a need for policies that, depending on the type of waste stream, incentivize collection, processing, and distribution of compost for agricultural use.

	N Reduction Potential	P Reduction Potential	C Sequest-ration Potential	Combined Nutrient/ Carbon Reduction Potential	Practice Cost
IL NLRS- Example statewide practice or scenarios					
Buffers	High	High	Medium	Medium	Medium Cost
Conservation Tillage	N/A	Low	Medium	Medium	Low Cost
Cover Crops (Scenario 1)	High	High	High	High	Low Cost
Cover Crops (Scenario 2)	High	N/A	High	High	Low Cost
Cover Crops (Scenario 3)	N/A	Low	Medium	Medium	Low Cost
N Rate Reduction	Low	N/A	N/A	N/A	N/A
N Application Timing	High	N/A	N/A	N/A	N/A
N Inhibitor Product	Low	N/A	N/A	N/A	Low Cost
N Application Timing (Scenario 1)	High	N/A	N/A	N/A	N/A
N Application Timing (Scenario 2)	Low	N/A	N/A	N/A	N/A
Perennial/Energy Crops (Scenario 1)	Low	Low	Medium	Medium	Medium Cost
Perennial/Energy Crops (Scenario 2)	High	Low	Medium	Medium	Medium Cost
Practices recognized by AFT in the CCS strategy					
Crop Rotation	Low		High	Medium	Low Cost
Strip Crops	Low		Low	Low	Low Cost
Practices recognized by NRCS COMET-Planner					
Nutrient Management (Replacing N Fertilizer with Soil Amendments)	High		High	High	High Cost
Riparian Forest Buffer	High		Medium	High	High Cost
Tree/Shrub Establishment - Farm Woodlot	Low		High	Medium	High Cost
Windbreak/Shelterbelt Establishment	Low		Medium	Medium	High Cost
Hedgerow Planting	Low		High	Medium	High Cost
Alley Cropping	Low		High	Medium	High Cost
Multi-story Cropping	Low		High	Medium	N/A
Conservation Cover - Retiring Marginal Soils	High		Low	Medium	Medium Cost
Herbaceous Wind Barriers	Low		Low	Low	Medium Cost
Vegetative Barriers	Low		Low	Low	N/A
Contour Buffer Strip	Low		Low	Low	Medium Cost
Filter Strip	High		Low	Medium	Low Cost
Grassed Waterway	Low		Low	Low	High Cost
Field Border	Low		Low	Low	Low Cost
Silvopasture Establishment on grazed grassland	High		High	High	High Cost
Range Planting	Low		Medium	Medium	Low Cost
Windbreak/Shelterbelt Renovation	Low		Low	Low	High Cost
Mulching	Low		Medium	Medium	Medium Cost
Conventional Tillage to No Till	Low		Medium	Medium	Low Cost
Prescribed Grazing	Low		Medium	Medium	Low Cost
Forage and Biomass Plantings - Partial Conversion	Low		Medium	Medium	Low Cost
Forage and Biomass Plantings - Full Conversion	Low		Medium	Medium	Medium Cost

Table 1. Comparison of conservation practices based on their reduction potential for nitrogen, phosphorus, and carbon, and cost.

Our analysis also highlighted silvopasture, the combination of trees and grazing, as a way to both stem nutrient loss and sequester carbon in the soil. Tree species could be selected for timber, or fruit or nut trees (e.g. hazelnuts) could be chosen as food-bearing options. Integration of silvopasture practices is an opportunity to return some of the land into native forest landscapes while still providing food, feed, and fiber. However, wide adoption of this practice is currently unlikely without significant changes in technical support, incentives, and policies that make silvopasture viable for farming operations in Illinois.

In order to ensure that those practices that align with both nutrient loss reduction goals and restoring soil health, we need to take action to prioritize these practices within conservation programs and initiatives across the state. For example, an existing though underfunded program, Partners for Conservation, could be turned into a healthy soils program that prioritizes adoption of cover crops. Furthermore, the NLRS Policy Working Group should consider including new practices that help address nutrients and carbon, such as the ones identified in this section.

Panel 1. In Michigan, Delta Institute is partnering with the City of Lansing's Public Service Department's CART program, Hammond Farms Landscaping Supply, and Live Green Lansing to develop and implement an innovative food scrap collection pilot program. The program is working with over 20 businesses in Lansing, MI to divert up to 500 tons of food scraps from landfills, and convert the scraps into a rich soil amendment that will be distributed back to the community, and to institutionalize food scrap diversion practices in a number of the restaurants beyond the pilot. While the focus of the pilot is on building out the collection side of the waste management system, the need to figure out how to scale the production and distribute the compost products to the farmers remains.

While this analysis only assessed potential benefits for adopting a single practice, we can use the NRCS COMET-Farm tool to further examine carbon benefits resulting from the integration of multiple practices at the field-scale.

Comparison of field-specific scenarios

Among the practices we highlighted in the previous section for their potential to have nutrient and carbon benefits, there are several practices that have been shown to work synergistically to improve soil health, inclusive of internal nutrient cycling and carbon sequestration. Broadly, these practices reflect the principles of reducing disturbance, increasing soil coverage, diversification, and the addition of animals or their manure. While the best combinations of practices will be site-specific to address local resource concerns, these general principles can be integrated in current or future management practices. This analysis is meant to be the first step to identify practices that have both water quality and carbon benefits, with future work needed to prioritize practices based on geography, climate, history, culture and knowledge, and access to markets.

Given the potential of carbon sequestration in Illinois soils, we explored a suite of scenarios that capture sequestration rates for a range of practices and rotations on typical fields across Illinois. COMET-Farm was used to estimate greenhouse gas fluxes for representative fields in Fulton, Richland, Livingston, Macon, and Iroquois Counties. COMET-Farm is similar to COMET-Planner, but it allows analysis at the field scale. The data in **Figure 3** represents average predictions for a 10-year period (2017-2026) across the 5 fields (weighted by acreage) for 6 different scenarios. The model outputs include above- and below-ground fluxes of carbon and nitrous oxide, which are converted to MT CO2e per acre per year. **Figure 3** also shows the total net emissions, with a positive value indicating that the field is a source and negative indicating a sink. The scenarios represent the types of practices reflecting the core soil health principles outlined by NRCS.

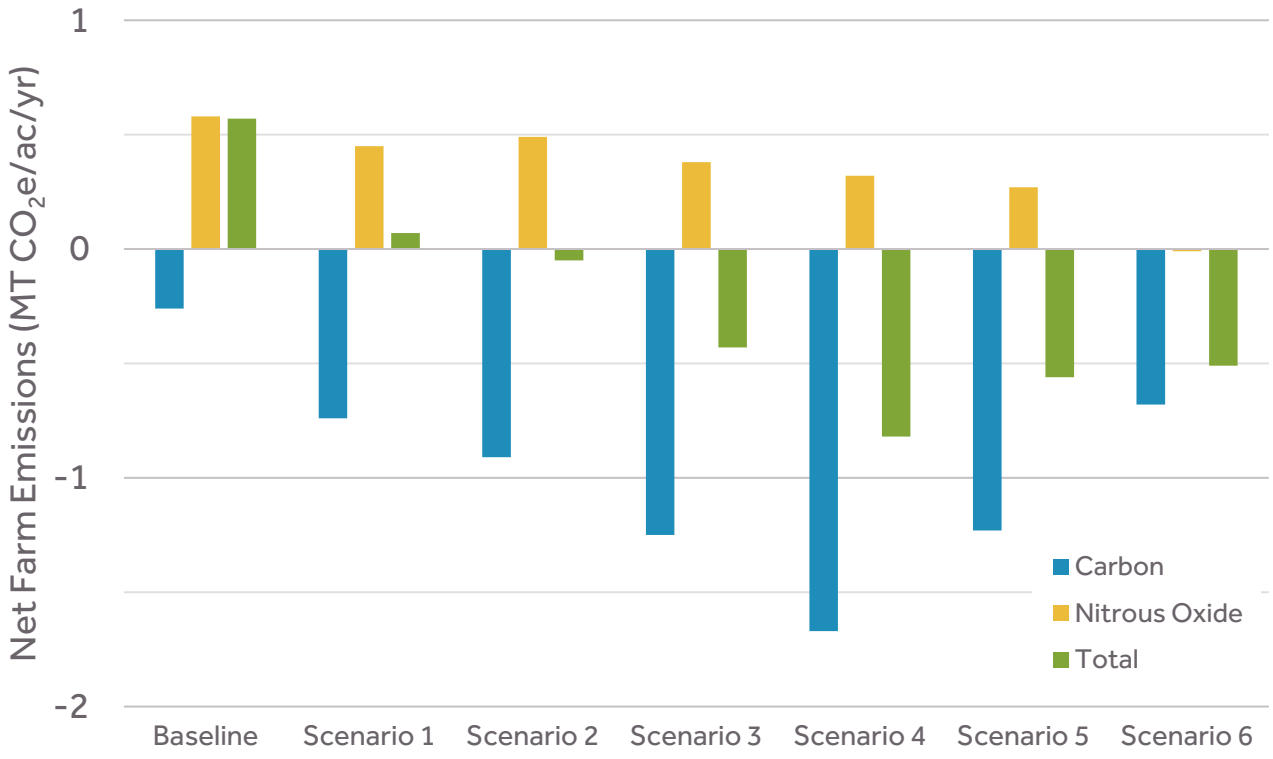


Figure 3. Net farm emissions based on COMET-Farm estimates for scenarios for 2017-2026 period compared to baseline conventional corn-soy rotation. The scenarios include: 1- Reduced tillage to no-till; 2 - Cover crops (oilseed radish after soy and cereal rye after corn) with reduced tillage; 3 - Cover crops plus no-till soy/corn; 4 - No-till soy/corn plus replacing synthetic N with legume cover crops and composted manure; 5 - No-till soy/wheat/corn plus replacing synthetic N with legume cover crops and composted manure; 6 - Conversion to switchgrass.

It is apparent that as we move from a conventional tillage system with synthetic fertilizer to one with cover crops (scenario 2) to one with cover crops and reduced tillage (scenario 3, 4) to introduction of organic amendments (scenario 5), to conversion to switchgrass (scenario 6) we see that the synergistic benefits of implementing these practices together grow. Looking at just the carbon storage, the rate reaches 1 MT CO_2e per acre per year suggesting that replenishing soil carbon to its potential in Illinois soils (62 MT CO_2e per acre) is a long-term process limited by physical and biological properties of the soils. This physical limit, in turn, ensures a supply of carbon for environmental markets for the next 50-70 years.

Research on soil biology continues to shed more light on synergistic benefits of implementing these practices as part of an integrated system. COMET-Farm and COMET-Planner are powerful tools that can help producers understand and quantify carbon storage benefits and track improvements in their soil health. **USDA-NRCS should be more proactive in training conservation practitioners in using COMET tools to help guide farmers in adoption of conservation practices. The addition of economic costs and benefits into the COMET suite of tools would also increase their utility.**

In addition, due to the significant historic carbon losses in Illinois soils, these results suggest that implementing conservation practices would allow for carbon storage for the next 50 years or more based on available sequestration capacity. Given the lack of current incentives and policies for carbon farming, opportunities to evaluate potential effectiveness of emerging mechanisms that offer market premiums to producers and associated policies are discussed in the following sections.

INVESTMENT & FINANCING BASED ON PRIVATE RETURNS

Development of financing strategies for emerging economic sectors has recently been demonstrated, such as the investment case for renewable energy, which 30 years hardly existed and nearly $250 billion was invested in 2016.[10] To reorient the agricultural system to one that provides foodstuffs while building soil, sequestering carbon, cleaning water, and enriching rural communities will require leadership in developing new financing strategies that draw on both public and private sources.

There is not only a need for additional capital to begin recarbonizing rural landscapes, but also a need for new ways of thinking about return on investment. A report released by Encourage Capital[11] in 2017 laid out opportunities to engage private capital and, in some cases, to leverage existing federal programs to improve natural resource conservation on agricultural landscapes. The report provided a conceptual framework to engage investors from across asset classes in investing in conservation-related outcomes and the outlined the steps to be taken by USDA or through new programs or initiatives.

The report also clearly provides opportunities to research, design, and test new pathways to mobilizing the capital needed to shift the investment and finance landscape. For instance, the report concedes that there is no current potential for private returns to be generated (and hence no opportunity for private investment) in activities like cover cropping, no-till, or installation of fences for managed grazing. This is mostly because of the lack of data on the financial performance of these practices. When taken together and implemented as a soil health management plan, there is early evidence showing that there is potential for a suite of private and public returns on these investments.[12] Private returns come in the form of reductions of labor and input costs, increased yields, and more resilience to extreme events.

Methodologies such as true-cost accounting, are being developed to reflect the full suite of costs and benefits of different agricultural production systems.[13] Internalizing those costs provides an opportunity for conservation investments that build soil, sequester carbon, and keep nutrients on the farm, all while supporting a more profitable farming enterprise. Advancements are still needed in the underlying measurement of physical changes (e.g. soil organic matter, nutrient cycles), developing financing mechanisms that better account for the social and environmental benefits of conservation cropping systems, and ultimately integration of biophysical and financial data that can inform farmers and investors about benefits and tradeoffs in investing in different cropping systems on the land.

One approach that can improve the decision support tools needed to shift land management systems is to integrate data from farmers (especially the early adopters) that demonstrate the costs and benefits of implementing suites of practices into existing databases such as the University of Minnesota's farm financial database (FINBIN), Iowa State University's Ag Decision Maker (AgDM), or the University of Illinois' Farm Business Farm Management (FBFM) program.

There may be opportunities to participate in formal or informal markets for water quality or carbon, but many of those are still in development, or have encountered policy-related roadblocks at the national level. An example of a program that engaged producers in carbon trading is described in **Panel 2**. Additional efforts have continued in the voluntary market, including the American Carbon Registry, Climate Action Reserve, and Verified Carbon Standard. The Coalition on Agricultural Greenhouse Gases (C-AGG) and the Noble Foundation are leading efforts to identify barriers and work on solutions to create market-grade carbon credits. Major hurdles include high transaction costs due to factors like verification, the challenges associated with ensuring that sequestered carbon actually stays in the soil long-term, and the lack of supportive national and global climate policies. An alternative to formal credit trading approaches are product certifications where consumers or supply chains pay a premium for a set of practices used in production.[14] These private returns are coupled with public returns, such as improvements in water quality, water infiltration (flood reduction), and carbon sequestration.

Panel 2. The Chicago Climate Exchange (CCX) offset program, active from 2003 to 2010, involved more than 15,000 farmers, ranchers, and forest landowners who enrolled over 25 million acres in agricultural and forestry carbon sequestration projects. The Iowa Farm Bureau and North Dakota Farmers Union operated the largest credit aggregation programs, with a combined 6 million acres of cropland earning credit for adopting continuous no-till practices. Delta Institute served as a project developer, starting with a small group of Illinois no-till farmers in 2005 and expanding to over 1,300 participants with 400,000 enrolled acres across 18 states by 2010.

Delta Institute also aggregated and sold carbon credits on behalf of the landowners to CCX cap-and-trade program members, who could use offsets for a portion of the greenhouse gas reduction commitments. The enrolled land was verified by a certified third-party organization, and the revenue from the sale, minus aggregation and trading fees, was returned to the landowners. While the CCX pilot ended in 2010 after a national climate and energy policy failed in Congress, the success of the offset program illustrates that it is possible to use a market mechanism to trade agricultural carbon credits on a large scale.

To engage investors and others with the ability to finance land, farm operations, and supply chain businesses, a stronger business case, in conjunction with a pipeline of investable opportunities, needs to be developed. Several projects led by nonprofit and supply chain partners are actively working to build this business case.[15] Early data has shown that potential exists for generating returns across several types of agricultural operations, practices, and geographies. **Additional work is needed to evaluate potential effectiveness of emerging mechanisms that offer market premiums to producers whose practices result in environmental benefits and to identify where it is most appropriate to engage investors interested in generating market-rate returns. Furthermore, there is a need to clarify where other sources of capital, such as government grants or philanthropic programs, may be more appropriate.**

As work is ongoing to develop comprehensive and sustainable funding frameworks for regenerative agricultural systems, numerous opportunities for investment have emerged. Drawing from the analysis in **Table 1**, to encourage the adoption of practices such as cover cropping, crop rotations, and nutrient management (specifically the replacement of synthetic N fertilizer with soil amendments), as strategies with both nutrient and carbon benefits, **significant investments will be needed to finance the supporting infrastructure. This includes expanding the capacity of: grain elevators to accept and process a wider variety of crops; supply chains to grow, collect, process, and distribute cover crop seeds; and the facilities and distribution networks to produce soil amendments from pre-consumer or post-consumer agricultural or food waste.** While investments are not the only barrier to broader adoption of soil health improving practices on the agricultural landscape, there is also a role for policy to encourage widespread adoption and provide supporting resources.

POLICY FOR IMPROVING SOIL HEALTH

In addition to technical knowledge and significant investments, shifting to regenerative agricultural systems will require policy changes that incentivize their adoption. A number of states have recently introduced or enacted legislation that create policies and programs to incentivize farmers and ranchers who adopt practices that improve soil health and enhance soil carbon. **Table 2** briefly summarizes their status and scope.

State	Bill # & Status	Description	Applicability to Illinois
Hawaii	Act 033 Signed into law June 2017	Establishes a Carbon Farming Task Force to develop policy/program recommendations	Appropriate starting place given the importance of agriculture in the state
New York	Bill 3281 Committee on Agriculture	Would establish a tax credit for farmers who use land management strategies that reduce GHG emissions or sequester carbon on farms, proposes to use COMET-Farm and COMET-Planner to quantify reductions	Most analogous to IL in terms of growing conditions and agricultural practices
Vermont	Bill S43 Committee on Natural Resources	Would establish a Regenerative Soils Program that would certify land as regenerative. Funding would come from certification fees and other appropriated funds/grants	Certifications tend to be onerous for producers and confusing for consumers
Maryland	HB 1067 Signed into law May 2017	Establishes the Maryland Healthy Soils Program	Signals to producers that it's a priority, but success uncertain without dedicated funding mechanism
Massachusetts	HB 3713 Joint Committee on Environment, Natural Resources and Agriculture	Would establish, develop and implement the Massachusetts Healthy Soils Program	See Maryland
California	Healthy Soils Initiative created in August 2016, $7.5M appropriated	Grants for implementation of approved practices and for setting up demonstration sites	Funding provided by the Greenhouse Gas Reduction Fund, which is unlikely in Illinois in the short term. However, the demonstration component of the initiative could be adopted for Illinois to foster education and outreach efforts

Table 2. Overview of state level policy proposals across the US and their potential applicability to Illinois.

The California Air Resource Board implements a cap-and-trade program for greenhouse gases that, in 2017, committed $7.5 million to fund the state's Healthy Soils Program, which supports implementation of agricultural conservation practices aimed at keeping more carbon in the soil. California's program also supports a set of projects specifically intended to serve as demonstration sites to further education and outreach for producers.

The approach being taken by New York State, which would require quantification tools such as COMET-Farm or COMET-Planner, could be effective in Illinois given similarities in cropping systems practices. Even though there is still a need for advancements in models and tools used, as discussed in previous sections of this strategy, this is a significant step to ensure that there is verification and consistency throughout. Furthermore, the link to tax credits could help incentivize conservation behavior among non-operating landowners, an important target group in Illinois where 60% of cropland is leased. Other states that proposed a healthy soils program, with exception of California, lack the dedicated funding mechanisms needed to support program implementation.

While it's too early to evaluate the success of these programs and proposals, it's encouraging to see a variety of approaches being explored. As it may not be currently feasible to shift Illinois' agriculture sector to focus on soil carbon through such legislation, the state should consider adapting Hawaii's program, which would create an entity that provides policy recommendations to support soil carbon and soil health in Illinois.

To take advantage of the opportunities to restore soil health, capture carbon, and improve water quality in Illinois, decision makers should be engaging with constituents to establish a program that drives resources and investment to support initiatives that aims to rebuild soil health in Illinois. Robust verification and tracking should be incorporated regardless of the financial mechanism involved. Of the states that are considering soil carbon programs, New York is probably the most analogous in terms of growing conditions and agricultural practices, and an indicator of what's feasible. California's program that supports demonstration projects could be an applicable model for Illinois to create a demonstration network program for public land that's leased for farming. This and other approaches to managing land owned by public agencies in Illinois are outlined in the Policy Briefs focusing on the role of state agencies In the NLRS implementation.[16] To advance this agenda in Illinois, leadership, innovation, and new partnerships will be key.

OPPORTUNITIES FOR ACTION

Based on our research and analysis, we have identified a number of action items for agencies and conservation stakeholders that can help further progress toward achievement of the Nutrient Loss Reduction Strategy goals and recarbonization of Illinois soils. Changing agricultural systems and rebuilding healthy soils across the Midwest is a long-term process and will not occur until programs and policies aimed at protecting farmland and natural resources come in alignment with our increasing understanding of soil biochemistry. In order to make progress, land management decisions should be guided by tools incorporating the latest research and be financially feasible. Though these components are rapidly developing, more work is needed to link the right information with the suitable tools and sufficient investment. This report outlines areas to focus on and actions that can help move Illinois toward recarbonized rural landscapes that provides water quality, climate, and community benefits.

Focus on practices with a C, N, and P benefits

Practices that can be implemented in synergy as part of a more regenerative cropping system to maximize environmental benefits and cost effectiveness should be prioritized for adoption. In addition to practices already identified in the NLRS, the practice of replacing synthetic N with soil amendments has high potential for water quality and carbon benefits and should be considered. However, for widespread adoption, further development of the supply chain for soil amendments is needed. The tools currently used to quantify potential benefits provide a snapshot of what's possible, but are not widely used. The tools are important factors in informing land managers and producers regarding practice benefits and provide practical information needed for more buy-in and implementation of practices. Furthermore, practices work in synergy with one another with the sum of the parts greater than the whole and the models need to be further improved to capture these interactions. Conservation programs should focus on adoption of a suite of practices to amplify benefits. In addition, aligning practice implementation with local soil characteristics and historical vegetation in Illinois would optimize the reductions.

Actions:

- Advocate for funding and redesigning the Partners for Conservation Program into a healthy soils program that focuses on priority practices;
- Amend the NLRS to include soil amendments and other high potential carbon practices;
- Conduct training workshops for NRCS staff in the Midwest on the suite of existing COMET tools and integrate financial information into the tools.

Develop novel investment mechanisms and finance infrastructure

Shifting the agricultural paradigm in Illinois, and across the United States, toward conservation will take investment not only in physical infrastructure, but in the tools, markets, and social capital needed for systemic change. There are also clear gaps in existing infrastructure that further investment can help address to facilitate changes in cropping systems.

Actions:

- Integrate data from farmers (especially the early adopters) that demonstrate the costs and benefits of implementing suites of practices into existing farm management databases and planning tools;
- Evaluate potential effectiveness of emerging mechanisms that offer market premiums to producers whose practices result in environmental benefits;
- Build and expand the capacity of production, collection and distribution infrastructure needed for implementation of new practices.

Implement policy

As states launch programs and advance legislation focused on rebuilding healthy soils through regenerative agriculture and carbon sequestration, Illinois, where agriculture is a prominent part of the physical, economic, and cultural landscape, should also be pursuing similar initiatives. Given the significant loss of carbon from soils, the scale of agriculture, and positive environmental outcomes, Illinois is poised to reap the benefits of integrated approach to carbon sequestration and nutrient loss reduction.

Actions:

- Develop a legislative strategy that includes establishing a taskforce, authorizing a healthy soils program, or expanding the Partners for Conservation Program to promote carbon farming.

APPENDIX

References

1. www.epa.illinois.gov/topics/water-quality/watershed-management/excess-nutrients/nutrient-loss-reduction-strategy/index

2. http://delta-institute.org/delta/wp-content/uploads/12-14-17-Part-1_Market-Drivers-Whitepaper.pdf

3. www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/soils/health/?cid=stelprdb1048859

4. www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/mgnt/

5. www.newfoodeconomy.org/how-carbon-farming-could-halt-climate-change/

6. Sanderman et al. 2017, available at: www.pnas.org/content/114/36/9575

7. www.farmlandinfo.org/conservation-cropping-systems-impactful-long-term-strategy-achieving-illinois-nutrient-loss

8. www.comet-planner.nrel.colostate.edu/

9. Hamilton, Abbe V., David A. Mortensen, and Melanie Kammerer Allen. 2017. "The State of the Cover Crop Nation and How to Set Realistic Future Goals for the Popular Conservation Practice." *Journal of Soil and Water Conservation* 72 (5): 111A – 115A.

10. http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2017.pdf

11. NRCS and Investment Capital: Investing in America Together, www.encouragecapital.com/publications/

12. www.daturesearch.com/upper-mississippi-river-basin/

13. www.sustainablefoodtrust.org/wp-content/uploads/2013/04/The-Future-of-Food-and-Agriculture-web.pdf

14. http://delta-institute.org/delta/wp-content/uploads/12-14-17-Part-1_Market-Drivers-Whitepaper.pdf

15. Soil Health Partnership, Soil Health Institute, and several USDA Conservation Innovation Grants.

16. bit.ly/delta2017nlrspolicybriefs

Additional relevant research literature on soil carbon

Abbott, Lynette K., and David A. C. Manning. 2015. "Soil Health and Related Ecosystem Services in Organic Agriculture." Sustainable Agriculture Research 4 (3): 116–25.

Biardeau, Léopold, Rebecca Crebbin-Coates, Ritt Keerati, Sara Litke, and Hortencia Rodríguez. 2016. "Soil Health and Carbon Sequestration in US Croplands: A Policy Analysis." https://food.berkeley.edu/resources/resources-by-topic/soil-health-resources/.

Blanco-Canqui, Humberto, Tim M. Shaver, John L. Lindquist, Charles A. Shapiro, Roger Wesley Elmore, Charles A. Francis, and Gary W. Hergert. 2015. "Cover Crops and Ecosystem Services: Insights from Studies in Temperate Soils." Agronomy Journal 107 (6): 2449–74.

Breakthrough Strategies & Solutions. 2017. "Sequestering Carbon in Soil: Addressing the Climate Threat." https://www.breakthroughstrategiesandsolutions.com/scc.

Chambers, Adam, Rattan Lal, and Keith Paustian. 2016. "Soil Carbon Sequestration Potential of US Croplands and Grasslands: Implementing the 4 per Thousand Initiative." Journal of Soil and Water Conservation 71 (3): 68A – 74A.

Conservation Technology Information Center, the North Central Region Sustainable Agriculture Research and Education Program, and the American Seed Trade Association. 2017. "Report of the 2016-17 National Cover Crop Survey."

Datu Research. 2017. "Cover Crops, No-Till, and the Bottom Line: Datu Case Studies." http://www.daturesearch.com/upper-mississippi-river-basin/.

Diepeningen, Anne D. van, Oscar J. de Vos, Gerard W. Korthals, and Ariena H. C. van Bruggen. 2006/1. "Effects of Organic versus Conventional Management on Chemical and Biological Parameters in Agricultural Soils." Applied Soil Ecology: A Section of Agriculture, Ecosystems & Environment 31 (1–2): 120–35.

Encourage Capital. 2017. "NRCS and Investment Capital: Investing in America Together." http://encouragecapital.com/publications/.

Haddaway, Neal R., Katarina Hedlund, Louise E. Jackson, Thomas Kätterer, Emanuele Lugato, Ingrid K. Thomsen, Helene Bracht Jørgensen, and Bo Söderström. 2015. "What Are the Effects of Agricultural Management on Soil Organic Carbon in Boreo-Temperate Systems?" Environmental Evidence 4 (1): 23.

Haddaway, Neal R., Katarina Hedlund, Louise E. Jackson, Thomas Kätterer, Emanuele Lugato, Ingrid K. Thomsen, Helene Bracht Jørgensen, and Per-Erik Isberg. 2016. "Which Agricultural Management Interventions Are Most Influential on Soil Organic Carbon (using Time Series Data)?" Environmental Evidence 5 (1): 2.

Kibblewhite, M. G., K. Ritz, and M. J. Swift. 2008. "Soil Health in Agricultural Systems." Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences 363 (1492): 685–701.

Machmuller, Megan B., Marc G. Kramer, Taylor K. Cyle, Nick Hill, Dennis Hancock, and Aaron Thompson. 2015. "Emerging Land Use Practices Rapidly Increase Soil Organic Matter." Nature Communications 6 (April): 6995.

Morriën, Elly, S. Emilia Hannula, L. Basten Snoek, Nico R. Helmsing, Hans Zweers, Mattias de Hollander, Raquel Luján Soto, et al. 2017. "Soil Networks Become More Connected and Take up More Carbon as Nature Restoration Progresses." Nature Communications 8 (February): 14349.

Paustian, Keith, Johannes Lehmann, Stephen Ogle, David Reay, G. Philip Robertson, and Pete Smith. 2016. "Climate-Smart Soils." Nature 532 (7597): 49–57.

Sanderman, Jonathan, Tomislav Hengl, and Gregory J. Fiske. 2017. "Soil Carbon Debt of 12,000 Years of Human Land Use." Proceedings of the National Academy of Sciences of the United States of America, August.

Schipanski, Meagan E., Mary Barbercheck, Margaret R. Douglas, Denise M. Finney, Kristin Haider, Jason P. Kaye, Armen R. Kemanian, et al. 2014. "A Framework for Evaluating Ecosystem Services Provided by Cover Crops in Agroecosystems." Agricultural Systems 125 (Supplement C): 12–22.

Snyder, C. S., T. W. Bruulsema, T. L. Jensen, and P. E. Fixen. 2009. "Review of Greenhouse Gas Emissions from Crop Production Systems and Fertilizer Management Effects." Agriculture, Ecosystems & Environment 133 (3–4): 247–66.

Soil Health Institute. 2017. "Enriching Soil, Enhancing Life: An Action Plan for Soil Health." https://soilhealthinstitute.org/soil-health-institute-announces-action-plan/.

Sommer, Rolf, and Deborah Bossio. 2014. "Dynamics and Climate Change Mitigation Potential of Soil Organic Carbon Sequestration." Journal of Environmental Management 144 (November): 83–87.

The Nature Conservancy. 2016. "Rethink Soil: A Roadmap for U.S. Soil Health." https://global.nature.org/content/rethinking-soil?src=r.v_soil.

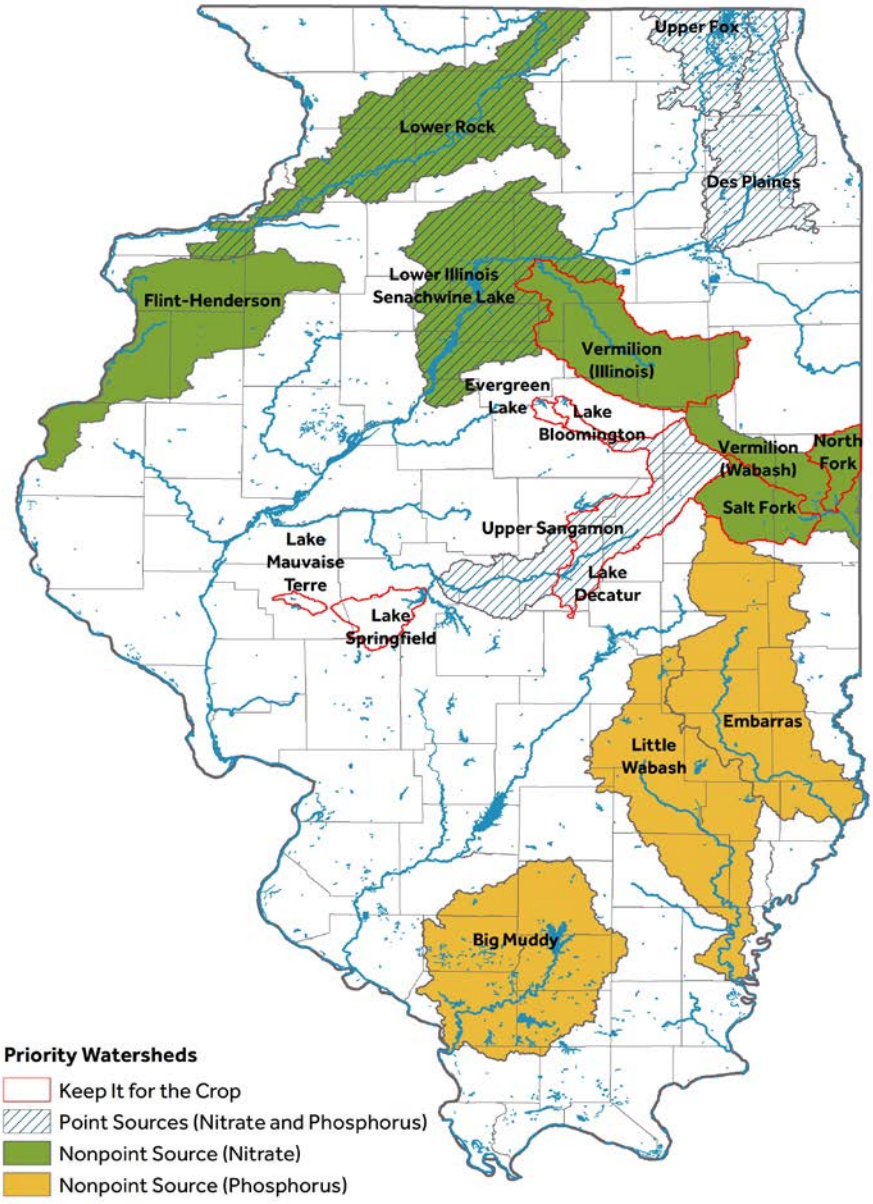
USDA Natural Resources Conservation Service. 2014. "Soil Health Sell Sheet."

USDA Natural Resources Conservation Service. 2015. "Soil Health Literature Summary — Effects of Conservation Practices on Soil Properties in Areas of Cropland."

Varvel, G. E., and W. W. Wilhelm. 2010. "Long-Term Soil Organic Carbon as Affected by Tillage and Cropping Systems." Soil Science Society of America Journal 74. Madison, WI: Soil Science Society: 915–21.

Veum, K. S., R. J. Kremer, K. A. Sudduth, N. R. Kitchen, R. N. Lerch, C. Baffaut, D. E. Stott, D. L. Karlen, and E. J. Sadler. 2015. "Conservation Effects on Soil Quality Indicators in the Missouri Salt River Basin." Journal of Soil and Water Conservation 70 (4): 232–46.

NLRS priority watersheds



Nutrient reduction and carbon sequestrations estimates and associated assumptions

(#) – designates assumptions used in estimating, see table below for explanation

	Acres per practice	Nitrate-N reduced		Practice Physical Effects (nutrients in surface water) (15)	Total P reduced		CO_2 reduced per year			Cost (18)
		per acre (%)	Total (million lb)		per acre (%)	Total (million lb)	CO_2e (MT per acre) (16)	N_2O (MT CO_2e per acre)	Total CO_2e (MT) (17)	
Practices recognized in the IL NLRS										
Buffers-Buffers on all applicable cropland	217,212 (1)	90	36		25-50	4.8	0.98	0.28	212,868	$623.65/ac
Conservation Tillage-1.8mn acres of conventional till eroding >T converted to reduced/mulch/no-till	1,800,000 (2)	NA	NA		50	1.8	0.13	0.07	234,000	$16.15/ac
Cover Crops (Scenario 1)-Cover crops on all corn/soybean tile-drained acres	9,263,000 (3)	30	84		30	4.8	0.32	0.05	2,964,160	$62.60/ac
Cover Crops (Scenario 2)-Cover crops on all corn/soybean non-tiled acres	12,281,000 (4)	30	33		NA	NA	0.32	0.05	3,929,920	$62.60/ac
Cover Crops (Scenario 3)-Cover crops on 1.6mn acres eroding >T converted to reduced/mulch/no-till	1,600,000 (5)	NA	NA		50	1.9	0.32	0.05	512,000	$62.60/ac
N Rate Reduction-Reducing N rate from background to MRTN on 10% of acres	2,236,100 (6)	10	2.3		NA	NA	0	0.11	0	NA
N Application Timing-Spring-only application on tile-drained corn acres	5,337,160 (7)	15-20	26		NA	NA	0	0.11	0	NA
N Inhibitor Product-Nitrification inhibitor with all fall applied fertilizer on tile-drained corn	5,337,160 (8)	10	4.3		NA	NA	0	0.11	0	$23.78/ac
N Application Timing (Scenario 1)-Split application of 40% fall, 10% preplant, and 50% side dress	5,337,160 (9)	15-20	26		NA	NA	0	0.11	0	NA
N Application Timing (Scenario 2)-Split application on 50% fall and 50% spring on tile-drained corn acres	5,337,160 (10)	7.5-10	13		NA	NA	0	0.11	0	NA
Perennial/Energy Crops (Scenario 1)-Perennial/energy crops equal to pasture/hay acreage from 1987	1,100,000 (11)	90	10		90	0.3	0.27	0.1	297,000	$473.40/ac
Perennial/Energy Crops (Scenario 2)-Perennial/energy crops on 10% of tile-drained land	970,600 (12)	90	25		50	0.3	0.27	0.1	262,062	$473.40/ac
Practices recognized by AFT in the CCS strategy										

Crop Rotation-Doubling the amount of extended rotation acreage (removing from CS and CC proportionally)	12,281,000 (4)	3	0.01	2	3	0.0005	0.21	0.01	2,579,010	$4.75/ac
Strip Crops-Strip cropping applied on 231,000 acres in the upper Midwest	100,000 (13)	NA	NA	2	23	1	0.11	0.13	11,000	$1.33/ac
Practices recognized by NRCS COMET-Planner										
Nutrient Management	2,236,100 (6)			5			1.8	0	4,024,980	$1000/ac
Riparian Forest Buffer	217,212 (1)			5			2.2	0.28	477,866	$694.18/ac
Tree/Shrub Establishment - Farm Woodlot	1,100,000 (11)			1			2	0.28	2,200,000	$664.00/ac
Windbreak/Shelterbelt Establishment	122,810 (14)			1			1.8	0.28	221,058	$0.66/ft
Hedgerow Planting	970,600 (12)			2			1.4	0.28	1,358,840	$0.81/ft
Alley Cropping	970,600 (12)			3			1.7	0.03	1,650,020	$4.91/ea
Multi-story Cropping	970,600 (12)			1			1.7	0.03	1,650,020	NA
Conservation Cover - Retiring Marginal Soils	122,810 (14)			4			0.98	0.28	120,354	$454.13/ac
Herbaceous Wind Barriers	122,810 (14)			1			0.98	0.28	120,354	$0.07/ft
Vegetative Barriers	122,810 (14)			2			0.98	0.28	120,354	NA
Contour Buffer Strip	122,810 (14)			2			0.98	0.28	120,354	$402.65/ac
Filter Strip	122,810 (14)			5			0.98	0.28	120,354	$125.32/ac
Grassed Waterway	122,810 (14)			2			0.98	0.28	120,354	$3513.65/ac
Field Border	122,810 (14)			2			0.98	0.28	120,354	$111.88/ac
Silvopasture Establishment on grazed grassland	1,800,000 (2)			5			1.3	0	2,340,000	$4.91/ea
Range Planting	1,800,000 (2)			1			0.5	0	900,000	$165.37/ac
Windbreak/Shelterbelt Renovation	122,810 (14)			1			0.4	0	49,124	$0.30/ft
Mulching	1,100,000 (11)			2			0.32	0	352,000	$243.55/ac
Conventional Tillage to No Till	1,800,000 (2)			2			0.42	-0.11	756,000	$15.21/ac
Prescribed Grazing	1,800,000 (2)			1			0.26	0	468,000	$51.68/ac
Forage and Biomass Plantings - Partial Conversion	1,800,000 (2)			1			0.21	0.01	378,000	$134.17/ac
Forage and Biomass Plantings - Full Conversion	1,800,000 (2)			1			0.27	0.1	486,000	$327.54/ac

Assumptions
(1) Buffers on all applicable cropland - 40,000 miles of rural streams x 35ft of buffers (per side) @ 64% (in NLRS scenario)
(2) 1.8mn acres of conventional till eroding >T converted to reduced/mulch/no-till
(3) Cover crops on all corn/soybean tile-drained acres - From NLRS Table 3.6 (.43*(12,412,000+9,132,000))
(4) Cover crops on all corn/soybean non-tiled acres - From NLRS Table 3.6 1-.43*(12,412,000+9,132,000)
(5) 1.6mn acres eroding >T converted to reduced/mulch/no-till
(6) Reducing N rate from background to MRTN on 10% of acres
(7) Spring-only application on tile-drained corn acres
(8) Nitrification inhibitor with all fall applied fertilizer on tile-drained corn
(9) Split application of 40% fall, 10% preplant, and 50% side dress
(10) Split application on 50% fall and 50% spring on tile-drained corn acres
(11) Perennial/energy crops equal to pasture/hay acreage from 1987 - From NLRS page 3-43
(12) Perennial/energy crops on 10% of tile-drained land - 9,706,000*.1 (NLRS table 3.6)
(13) Approximate IL share of Upper Midwest stripcropping
(14) From NLRS Table 3.6 .01*(1-.43*(12,412,000+9,132,000))
(15) Conservation Practice Physical Effects (nutrients in surface water) from https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/technical/cp/ncps/?cid=nrcs143_026849
(16) From COMET-Planner, results from IL
(17) Acres per practice * CO_2 (MT CO_2e per acre per year). Note: Some practices also result in a N_2O change, a greenhouse gas, but given the focus of this report on soil carbon, those emissions are not included here
(18) IL Practice cost data from https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1327812&ext=pdf, where available
(18a) Compost price ($50/ton) * application rate (20 tons/acre)
(19) Upfront cost associated with practice implementation on per acre basis (Low Cost- $0-$203; Medium Cost- $204-$652; High Cost- $653 and up)
(19a) Windbreak/Shelterbelt establishment- ft. converted to ac. Following NRCS job sheet
(19b) Hedge row planting-ft. converted to ac. Following NRCS job sheet
(19c) Alley cropping-each converted to ac. Following NRCS job sheet
(19d) Herbaceous wind barriers-ft. converted to ac. Following NRCS job sheet
(19e) Windbreak renovation-ft. converted to ac. Following NRCS job sheet
(19f) Silvopasture establishment on grazed grassland-each converted to ac. Following NRCS job sheet

Proposed legislation overview

The **State of Hawaii's** Act 033, signed in June 2017, establishes a Carbon Farming Task Force (until 2025) within the Office of Planning that is responsible for identifying agricultural and aquacultural practices that provide carbon sequestration benefits that may be used to provide a carbon farming certification. The Task Force will provide a report with recommendations on proposed legislation, discussion of practices and policies with on-farm greenhouse gas mitigation benefits, benchmarks and criteria for certification, and associated incentives to promote the identified activities.

The **New York State Assembly** has introduced Bill 3281, which is currently in Committee on Agriculture, to establish carbon farming tax credit to reward and incentivize farmers to maintain or adopt practices that help maximize NY's carbon sequestration potential. Quantification and certification should occur via USDA's COMET-Farm and COMET-Planner tools as determined by the commissioner of Environmental Conservation. Department of Environmental Conservation should also cooperate with the Department of Agriculture and Markets to develop educational materials to promote carbon farming and use of quantification tools.

The **Vermont State Senate** has introduced Bill S43, which is currently in Committee on Natural Resources, to establish a Regenerative Soils Program. The program would be implemented by the Agency of Natural Resources to encourage landowners, including farmers engaged in conventional farming, to transition to regenerative soil practices and implement certification to give regenerative farmers and landowners the opportunity to be certified as a regenerative, soil-building, carbon-sequestering, watershed-cleaning property. The bill also calls for the creation of the position of the Director of Regenerative Soils, charged with administering the Regenerative Soils Program, creating policies and programs to help conventional farmers transition away from dependency on tillage and chemicals and to regenerative, soil-building practices, and creating policies and programs to incentivize regenerative farmers to continue their work. The Regenerative Soil Fund from certification payments will fund the Regenerative Soil Program.

In May 2017, **Maryland's** House Bill 1063 was signed into law. It established the Maryland Healthy Soils Program. The program administered by the Maryland Department of Agriculture is to encourage adoption of healthy soil practices through research, education, technical assistance, and financial incentives, subject to available funding. The state has not yet identified funding sources to provide financial assistance to farmers to implement farm management practices that contribute to healthy soils.

The **Massachusetts** legislature is considering Bill H3713, that would create a Massachusetts Healthy Soils Program, similar to that of Maryland and California. The program would be administered by the state's Department of Agricultural Resources to "enhance the education, training, employment,

income, productivity and retention of those working or aspiring to work in the field of regenerative agriculture" and develop a basis for further incentives in the future. The bill is currently referred to the Joint Committee on Environment, Natural Resources and Agriculture. There is currently no specified source of funding to implement the program.

California's Healthy Soils Initiative, established in 2016 to help achieve the state's greenhouse gas emissions reductions through carbon sequestration in and on natural and working lands, is a collaboration of state agencies and departments, led by the California Department of Food and Agriculture (CDFA). The Healthy Soils Initiative's goal is to promote the development of healthy soils on California's farm and ranchlands. In fiscal year 2016-2017, California's budget appropriated $7.5 million to develop and administer a new incentive and demonstration program through the Healthy Soils Initiative supported by the Greenhouse Gas Reduction Fund. Applications for implementation and demonstration projects (3 year timeline) were due in September 2017 with awards announcements scheduled for December 2017.