



2018 NREC Funded Research Projects
Project Objectives

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
<u>A comprehensive corn nitrogen research program for Illinois</u>	UI	Nafziger	2014-2018	\$143,661
<u>The effect of cover crops on surface water quality: A paired watershed experiment in the Lake Bloomington Watershed</u>	ISU	O'Reilly	2014-2019	\$193,627
<u>Multifunctional buffers on marginal farmland to improve the environmental profile of agriculture and diversify production opportunities</u>	UI	Lovell	2014-2018	\$117,643
<u>Nitrogen management systems in tile-drained fields: Optimizing yields while minimizing losses</u>	UI	David/Gentry	2014-2019	\$200,580
<u>Nitrate leaching in cover crops and corn/soybean systems in Southern Illinois With N15</u>	SIU	Schoonover	2015-2019	\$103,175
<u>tracking soil nitrogen loss and availability</u>	UI	Nafziger	2015-2017	\$93,454
<u>Demonstration and monitoring of nutrient-removal wetlands in the Big Bureau Creek watershed (Northern/Central Illinois)</u>	The Wetlands Initiative	Kostel	2015-2018	\$140,000
<u>Evaluating nutrient loss reduction strategies: longer rotation with cover crops and bioreactor</u>	UI	Gentry	2015-2019	\$124,817
<u>Industry and University Partnership & KIC 4R Programs</u>	IFCA	Schaefer	2016-2018	\$494,669
<u>The two-stage saturated buffer: Integrating the use of cover crops into saturated buffer designs for nitrogen mitigation</u>	SIU	Schoonover	2016-2018	\$88,592

Assessing synergies and tradeoffs of recommended BMPs to reduce nutrient loss	UI	Pittelkow	2016-2019	\$141,738
Dissolving uncertainty: A comprehensive evaluation of dissolved P in tile drainage	UI	Christianson	2016-2018	\$36,316
Understanding mechanisms and processes of dissolved reactive phosphate (DRP) loss in Illinois tile-drained fields	UI	Arai	2016-2019	\$128,658
Cereal Rye Ahead of Corn: N Catch and Release	UI	Gentry	2017-2019	\$91,003
Web-based Decision Support Tool for Cover Crop Management	UI	Coppess	2017-2019	\$130,618
A Long-term Evaluation of Nitrogen Application Timing and Cover Crops Impacts on the Fate and Availability of Nitrogen Fertilizer and Crop Production on Tile Drained Fields	ISU	Armstrong	2017-2019	\$207,943
Drainage water management and saturated buffers for achieving NLRs goals	UI	Christianson	2017-2020	\$126,197
Bioreactors for Illinois: Smaller, Better, Faster	UI	Christianson	2017-2020	\$79,024
Managing Phosphorus Loss from Midwest Agroecosystems: State of Knowledge Review	SIU	Willard	2018	\$34,155
Towards Management of Dissimilatory Nitrate Reduction to Ammonium for Nitrate Retention in Agricultural Soils	UI	Kent	2018-2019	\$143,438
Assessing Suitability and Benefits of Cover Crops in Illinois	UI	Guan	2018-2020	\$126,566
Assessing tile depth and spacing impact on nutrient losses and crop production	UI	Bhattarai	2018-2020	\$155,014
Water quality and agronomic impacts of gypsum applications in Southern Illinois	SIU	Willard	2018-2021	\$119,436
Reducing P Loss in Southern Illinois: Producers, Practices, and Productivity	UI	R. Christianson	2018-2021	\$190,147
Evaluating slow-release P fertilizers to increase crop production and environmental quality	UI	Margenot	2018-2021	\$56,158
On-Farm Evaluation and Demonstration of Reduced Off-Farm Nutrient Transport through Drainage Water Recycling	UI	Cooke	2018-2021	\$130,954

ONGOING PROJECTS:

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
A comprehensive corn nitrogen research program for Illinois	UI	Nafziger	2014-2018	\$114,234

Objectives

1. To gather data on the response of corn grain yield to N fertilizer rates when corn follows soybean in rotation and when corn follows corn, with replicated, field-scale, N rate trials at numerous on-farm locations throughout Illinois, representing the large diversity of soils and weather in the State. Some of these will include treatments comparing fall-applied and spring-applied fertilizer N rates.
2. To compare combinations of fertilizer N rate, form, inhibitor treatments, and application timing on corn yield and economic return using smaller-plot approaches on UI research centers.
3. Beginning in 2016, to address the NREC priority on late N application using UAN injected preplant and Y-drop method for late application.
4. To continue trials to address testing nitrification inhibitors. We already have several inhibitor treatments in our trials. We will also do some lab testing of inhibitor effects, if this information does not already exist, by adding the inhibitor along with fertilizer N to soil in containers and taking periodic samples to measure the rate of conversion of ammonium to nitrate.
5. To continue trials that began in 2016, to address the NREC priority of evaluating the utilization of N from DAP and/or MAP in comparison to TSP to determine degree of loss or utilization of nitrogen in DAP or MAP for both fall and spring application. We have such studies in 2016 at two sites (Urbana and Monmouth) and will continue these for two more years. These trials are designed to compare fall-applied DAP, spring-applied DAP, and spring-applied UAN as N sources at different N rates.
6. To include a final written report at the conclusion of this project to address each of the objectives listed above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
The effect of cover crops on surface water quality: A paired watershed experiment in the Lake Bloomington watershed	ISU	O'Reilly	2014-2019	\$172,159

Objectives:

The goal of this project is to understand how cover cropping at large spatial scales affects nutrient loss, without altering other farming practices.

Our objectives are as follows:

1. To determine nitrogen and phosphorous losses by comparing tile drainage water quality from two watersheds, one of which is cover cropped.

2. To relate patterns in nutrient loss to cover crop biomass, nutrient uptake and soil nitrogen.
3. To compare differences in the effectiveness of cover cropping after soybeans relative to after corn.
4. To develop a hydrologic model of the cover cropped watershed that can be used to explore alternative farming practices and climate change impacts.
5. To conduct an economic assessment of large-scale cover crop implementation.
6. To provide information and outreach for local farmers on the use and effectiveness of cover crops.
7. A final objective is to include a final report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Multifunctional buffers on marginal farmland to improve the environmental profile of agriculture and diversify production opportunities	UI	Lovell	2014-2018	\$120,667

Objectives:

The long-term goal of our research is to develop and evaluate strategies for our Illinois agricultural landscape that optimize nutrient recovery and reduce greenhouse gas emissions, while maximizing profitability for the farmer. Our goal in this proposal is to establish and evaluate different multifunctional perennial systems appropriate for marginal or sensitive areas (e.g. sloped land, floodplains, etc.) on Illinois farms.

1. Establish replicated long-term studies to compare different multifunctional buffer systems at three of the University of Illinois Research Stations.
2. Evaluate the environmental benefits of multifunctional buffer treatments related to nitrogen recovery through the analysis of soil nutrient fractions over time, leaching of nutrients in the subsurface zone, and abundance of key nitrogen-cycling microorganisms.
3. Conduct Life Cycle Assessment to study Greenhouse Gas (GHG) emissions and eutrophication impact for the eight multifunctional buffer systems, using data from field plots to supplement values from the literature.
4. Compare the profitability of the eight multifunctional buffer treatments including labor and resource requirements and develop a prototype farm planning tool for optimizing profitability and environmental benefits of multifunctional buffers.
5. Include a final report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Nitrogen management systems in tile-drained fields: Optimizing yields while minimizing losses	UI	David/Gentry	2014-2019	\$245,573

Objectives:

The overall goal of this project is to more fully understand current and new nitrogen management systems on corn yields and nitrate losses from tile-drained fields in Illinois.

The objectives are to:

1. To develop on-farm field trials of current and new nitrogen management systems for typical corn/soybean rotations, evaluating both the yield response and the tile losses of nitrate.
2. To determine when and why tile nitrate losses occur in these management systems, during both corn and soybean rotations.
3. Include a final report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Nitrate leaching in cover crops and corn/soybean systems in Southern Illinois With N15	SIU	Schoonover	2015-2019	\$95,907

Objectives:

1. Evaluate nitrate-N leaching under legume/non-legume cover crops at field scale.
2. Evaluate nitrate-N Leaching due to the interactions with tillage.
3. Estimate nitrate-N load losses based on location conditions.
4. Evaluate the influence of cover crops (Hairy vetch and cereal rye) on nutrient dynamics and leaching at different topographic positions on a watershed scale.
5. Evaluate the contribution of cover crops in building soil carbon pools (total carbon, active carbon or potassium permanganate oxidizable carbon and water extractable carbon).
6. Evaluate the influence of cover crops in improving soil water holding capacity.
7. Include a final report at the conclusion of this project to address each of the objectives stated above.

Our goal is to gain critical knowledge about how long-term cover cropping, tillage practices and topography contribute to nitrate leaching. This knowledge will enable us to optimize crop yields, maximize nutrient utilization and minimize the environmental impact due to N leaching. An addendum to this project was added in 2015 to study 15N on micro-plot scale and trace N in three different pools including plant, soil and water for better understanding of the N cycling within the system. This research blends replicated micro-scale 15N study with field-scale experiments up to watershed-scale research.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Tracking soil nitrogen loss and availability	UI	Nafziger	2015-2017	\$187,572

Objectives:

1. To use soil N data that might be available from the N-Watch program that started in fall 2012 to supplement data gathered under this proposed project to produce a predictive model of how soil N amount in the soil at any point during the growing season is affected by the form and timing of N fertilizer applications and by weather conditions that follow N fertilizer application.
2. To apply different N timing and form treatments in replicated studies at twelve sites in Illinois, beginning in the fall of 2014, and to sample soils periodically following N application in order to monitor soil nitrate and ammonium into and through the cropping season in order to see how much N remains in the soil, and by subtraction how much has moved out of the soil.

3. To include at each of the twelve monitoring sites an N rate trial next to the N-monitoring site in order to match soil N observations with N responses.
4. To use both the model and the results from soil sampling in real time to develop estimates of the fate of N applied on the amount of N left as the season progresses.
5. To combine modeled estimates and actual soil N amounts into a publicly-available website and a smartphone App that will enable the user to input N form and time of application, and to receive, for that soil type and region, an estimate of how much N remains in the soil and in what form.
6. To include a final written report at the conclusion of this project to address each of the objectives listed above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Demonstration and monitoring of nutrient-removal wetlands in the Big Bureau Creek watershed (Northern/Central Illinois)	The Wetlands Initiative	Kostel	2015-2018	\$140,000

Objectives:

The project goal is to advance the use of small, precisely placed constructed wetlands on farm properties along or within ditches or headwater streams to capture nutrient runoff from tile drainage. Pairing nutrient management practices with innovative nitrogen-removal practices such as wetlands is essential to achieving nutrient reduction goals, but farm-based wetlands have been severely underutilized in Illinois to date as part of the toolkit of conservation practices to improve water quality.

- 1) To provide technical assistance to at least four farmers in installing a constructed wetland “demonstration site” on their properties;
- 2) With project partner Dr. Karl Rockne of UIC, to conduct water quality monitoring of a wetland demonstration site to better understand the exact processes of nutrient removal and to develop a cost-effective monitoring protocol for the wetlands;
- 3) To promote replication of the wetland practice by peer landowners via field demonstration days and other outreach; and
- 4) To include a final report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Evaluating nutrient loss reduction strategies: longer rotation with cover crops and bioreactor	UI	Gentry	2015-2019	\$160,973

Objectives:

The main objective of this study will be to test the effectiveness of a longer rotation with cover crops in combination with a bioreactor to decrease tile nitrate loss and directly examine this potential nutrient loss reduction scenario on a field-scale production system.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Industry and University Partnership & KIC 4R Programs	IFCA	Schaefer	2016-2018	\$447,002

Objectives:

There are four on-going NREC projects that this proposal will support as outlined below. The University of Illinois project investigators will provide details of the specific project work plan and objectives in their proposal; this proposal defines how we help coordinate those projects with farmer and ag retail cooperators and an outreach component. **The goal of this proposal** is to facilitate professional, consistent and reliable implementation of the treatments at these NREC research sites to produce viable, useful data to the researchers to achieve their goals of analyzing, publishing and communicating results that can be applied across many acres in Illinois to improve nutrient utilization and reduce nutrient losses.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
The two-stage saturated buffer: Integrating the use of cover crops into saturated buffer designs for nitrogen mitigation	SIU	Schoonover	2016-2018	\$82,453

Objectives:

1. Compare nitrate leaching among drainage tiles managed with a grass strip (control), a saturated buffer with a grass strip (treatment 1), and a saturated buffer with a grass strip coupled with a cover crop strip (treatment 2).
2. Estimate runoff volumes reaching the tile outlet among the three aforementioned drainage scenarios.
3. Quantify the economic costs and benefits associated with the control and two saturated buffer treatments.
4. Include a final report at the conclusion of this project addressing the objectives above.

The overarching goal of this research is to provide farmers and land managers with data pertaining to multiple best management practices designed to mitigate nitrogen in tile-drained systems. These data will illustrate the quantity of nitrogen that can be retained on a site and will offer insight into economic savings through the reduction of the environmental loss of fertilizers (i.e., assimilation by the cover crop).

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Assessing synergies and tradeoffs of recommended BMPs to reduce nutrient loss	UI	Pittelkow	2016-2019	\$131,640

Objectives:

The overall goal of this project is to generate and communicate new information about best practices for balancing nutrient management, water quality, and corn production goals in Illinois. This experiment is the first of its kind to ask the question: are current recommendations primarily minimizing environmental impacts with

respect to nitrate losses, but having negative impacts on crop productivity, nutrient utilization, tile drainage P losses, and/or N₂O emissions?

This project has the following objectives:

1. Determine the effects of combining recommended water quality BMPs on tile drainage nutrient losses, field N and P balances, and fertilizer use efficiencies.
2. Considering a best-case scenario (e.g. 4R nutrient stewardship + cover crops + bioreactor), assess whether synergies are occurring among practices, and/or there is an upper limit to nutrient loss reductions.
3. Using plots without fertilizer inputs as a baseline, assess the relative contribution of soil vs. fertilizer sources to annual N and P losses for continuous corn production systems.
4. Evaluate whether recommended BMPs reduce nitrate losses but increase N₂O emissions.
5. Evaluate whether cover crops and bioreactors reduce nitrate losses but increase tile drainage P losses under certain conditions.
6. Assess crop yields and relative cost efficiencies of recommended BMPs.
7. Evaluate (through modeling) how environmental tradeoffs can be managed at the landscape/watershed-scale using different combinations of BMPs.
8. Communicate results to agricultural community stakeholders through field days and extension events.
9. Include a final written report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Dissolving uncertainty: A comprehensive evaluation of dissolved P in tile drainage	UI	Christianson	2016-2018	\$42,153

Objectives:

The major goal of this work is to improve understanding of factors impacting the occurrence of dissolved reactive phosphorus (P) in Midwestern subsurface drainage waters.

The specific assessable objectives are to:

1. Further develop the Measured Annual Nutrients for Agricultural Environments (MANAGE) database through addition of drainage nutrient concentration data, specifically dissolved reactive P but also including other forms of P and N.
2. Statistically analyze the newly assembled nutrient concentration database to determine the effect of controllable factors (e.g., precipitation, soil drainage class) upon P concentrations in drainage water
3. Per the RFP, the final objective is *“to include a final report at the conclusion of this project to address each of the objectives stated above.”*

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
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Understanding mechanisms and processes of dissolved reactive phosphate (DRP) loss in Illinois tile-drained fields	UI	Arai	2016-2019	\$167,151
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Objectives:

The overall goal of this project is to evaluate physicochemical factors (e.g., soil test P, landscape topography, infiltration rate, and soil chemistry) influencing the seasonal distribution and movement of DRP in tile drainage systems. We will more fully understand the fate of DRP in relation to soil test P in current P management systems at long term tile-drained experimental fields in Illinois.

The objectives are to:

1. fully understand tile DRP losses in relation to soil test P (i.e., labile P in surface soils) for fields in east-central Illinois under typical corn and soybean production;
2. assess tile DRP losses in relation to spatial variability (i.e., fine scale topography) across fields and landscapes;
3. determine the relationship between land surface topography and tile DRP losses, examining soil physical properties (e.g., infiltration rate, hydraulic conductivity, soil P extraction relevant to soil test P);
4. examine the processes responsible for seasonal DRP release to tile lines, including physicochemical properties (e.g., depth sequence distribution of DRP and agronomic P soil test P) of subsurface soils; and
5. include a final report at the conclusion of this project that will address each of the objectives stated above and evaluate both the yield response and the tile losses of DRP/changes in soil test P.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Cereal Rye Ahead of Corn: N Catch and Release	UI	Gentry	2017-2019	\$58,653

Objectives:

The main objective of this study is to learn how to best manage cereal rye as a winter cover crop before corn in either a corn/soybean rotation or in continuous corn. Our experimental design will accommodate three corn N fertilizer treatments (fall vs. spring vs. side-dress) with and without cereal rye and three spring cover crop termination dates (approximately 2 weeks apart). This design will allow us to investigate N release from the cover crop under various N fertilizer regimes and to evaluate N immobilization vs. allelopathy in regard to negative cover crop effects on the subsequent corn crop.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Web-based Decision Support Tool for Cover Crop Management	UI	Coppess	2017-2019	\$135,589

Objectives:

The ultimate objective of this proposal is to provide farmers with a practical decision support tool that they can use in their fields to manage cover crops effectively. It will put to use existing and future research to demonstrate the potential of cover crops and increase adoption of this important practice. The final tool will be a web-based software application that can provide farmers, researchers, extension educators and others in the industry with data and information about cover crops in a practical, visualized format. Initial seed funding has produced a proof-of concept web interface that was the first step in the overall project (see, Part VIII, page 8).

This proposal to NREC is to advance the overall project through the initial developmental stage. The tool will provide information about cover crop growth integrated into common cropping systems, starting with cereal rye added to a corn-soybean rotation. When completed, the tool will:

- simulate growth of the cover crop, including termination scenarios across multiple fields in the farm operation;
- estimate biomass in the field;
- estimate the carbon-to-nitrogen ratio;
- estimate the amount of carbon, nitrogen and water stored in the cover crop; and
- provide estimates of the impact on soil moisture and field conditions, nutrient loss and water quality from the cover crop in each individual field.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
A Long-term Evaluation of Nitrogen Application Timing and Cover Crops Impacts on the Fate and Availability of Nitrogen Fertilizer and Crop Production on Tile Drained Fields	ISU	Armstrong	2017-2019	\$210,095

Objectives:

1. Quantify the impact of N application timing (fall and spring) and cover crop inclusion on corn and soybean N uptake and yield, distribution of soil N, and nitrate loss through tile drainage.
2. Investigate the impact of N application timing and cover crop inclusion on N₂O release during the year.
3. Utilize 15N methods to identify whether cover crops primarily take up soil or fertilizer N.
4. Determine the impact of cover crops on the fate and availability of fall and spring applied fertilizer N (mineralization, immobilization, nitrification, conversion to soil OM, leaching, and plant uptake) using 15N methodology.
5. Utilize 15N methods to determine the synchrony of the timing and quantity of cover crop residue N release and corn and soybean N demand.
6. Develop an economic model to evaluate the value/risk of cover crops based on 5 years of agronomic and environmental data.
7. Include a final report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
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Drainage water management and saturated buffers for achieving NLRS goals	UI	Christianson	2017-2020	\$115,749
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Objectives:

The goal of this work is to evaluate N loss reduction provided by drainage water management and saturated buffers to assess their potential inclusion as recommended practices in the NLRS.

The specific assessable objectives are to:

1. Monitor drainage water management and saturated buffer sites for nutrient loss reduction and crop yield impacts.
2. Develop a water balance at the drainage water management sites to better quantify lateral seepage impacts upon the overall nutrient loss reduction.
3. Perform an economic evaluation of these two practices (\$ per acre treated and \$ per pound of nitrogen removed).
4. Evaluate if these practices should be added to the IL NLRS. And if so,
 - a. Develop an appropriate N loss reduction value to add to the NLRS tables.
 - b. Develop a procedure and seek approval for adding drainage water management and/or saturated buffers to the NLRS.
5. Per the RFP, the final objective is *“to include a final report at the conclusion of this project to address each of the objectives stated above.”*

Project Title	Institution	Primary Investigator	Proposed Project Period	2017 Project Budget
Bioreactors for Illinois: Smaller, Better, Faster	UI	Christianson	2017-2020	\$158,992

Objectives:

The major goal of this work is to test novel full-size bioreactors intended to maximize nitrogen removal from drainage water while limiting land removed from production.

The specific assessable objectives are to:

1. Design and build four new types of denitrifying bioreactors in Illinois:
 - a. Two Ditch Bioreactors
 - b. One High-Flow Booster Bioreactor
 - c. One Heat-enhanced Bioreactor
2. Compare the nutrient removal efficiency and hydraulic performance of these novel bioreactors to existing conventional bioreactors.
3. Perform an economic evaluation of these novel bioreactors (\$ per acre treated and \$ per pound of nitrogen removed).
4. Per the RFP, the final objective is *“to include a final report at the conclusion of this project to address each of the objectives stated above.”*

NEW PROJECTS

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
Managing Phosphorus Loss from Midwest Agroecosystems: State of Knowledge Review	SIU	Willard	2018	\$34,155

Objectives:

This review paper will evaluate emerging practices in P management to give NREC/stakeholders the knowledge they need to optimize funding for P research in Illinois. This review will also highlight gaps in research on managing P to identify opportunities for the future.

Specific objectives:

1. To review the published research on managing phosphorus loss from the agricultural cropping systems of Illinois as well as from other Midwestern States.
2. To classify available research papers on basis of best management practices and their efficacy in reducing P loss and to highlight gaps where additional research may be needed for managing P losses with changing cropping systems (including cover crops and conservation tillage).
3. Include a final report at the conclusion of this project to address each of the objectives stated above and develop a white paper, peer-reviewed journal article, and extension fact sheet to disseminate results.

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
Towards Management of Dissimilatory Nitrate Reduction to Ammonium for Nitrate Retention in Agricultural Soils	UI	Kent	2018-2019	\$143,438

Objectives:

The *overall goal* of the proposed research is to improve understanding of the controls on DNRA in Illinois agricultural soils.

Specific objectives:

1. Quantify drivers of DNRA rates across representative Illinois soil types,
2. Identify controls on DNRA gene expression in soil microbial communities, and
3. Assess identified conditions *in situ* to verify controls on rates of DNRA and evaluate reduction in NO₃ leaching.
4. We will produce a final report at the conclusion of this project to address each of the objectives stated above. In this report, we will outline the prospects for future investigations that can capitalize on our results.

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
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Assessing Suitability and Benefits of Cover Crops in Illinois	UI	Guan	2018-2020	\$126,566
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Objectives:

1. Empirical analysis of biophysical and yield effects of cover crops at regional scales through data synthesis/literature review.
2. Process-based modeling of biophysical/biogeochemical impacts and yield of current and proposed agroecosystem practices: implementation and validation.
3. Suitability and potential benefit assessments of cover crops using the process-based model.
4. Economic suitability assessments for cover crops.

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
Assessing tile depth and spacing impact on nutrient losses and crop production	UI	Bhattarai	2018-2020	\$155,014

Objectives:

The overall goal of this project is to produce and communicate new information about best practices for balancing drainage depth and spacing, water quality, and crop production goals in Illinois. This experiment is the first of its kind to ask the question: how do current recommendations on drainage depth and spacing influence not only nutrient losses, but also crop productivity, and nutrient utilization? Can drainage depth and spacing be optimized to minimize the nutrient losses and maximize the crop production?

This project has the following specific objectives:

1. Determine the effects of tile depth and spacing on tile drainage nutrient losses, field N and P balances, and fertilizer use efficiencies through a series of field experiments.
2. Assess whether drainage design can be optimized to reduce nutrient loss reductions and increase the crop production.
3. Develop a design tool to optimize the drainage design that can be used by researchers, drainage contractors, and farmers.
4. Communicate results to agricultural community stakeholders through field days and extension events.
5. Include a final written report at the conclusion of this project to address each of the objectives stated above.

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
Water quality and agronomic impacts of gypsum applications in Southern Illinois	SIU	Willard	2018-2021	\$119,436

Objectives:

To assess whether gypsum can be a tool for southern Illinois farmers to limit phosphate loss from their fields, while maintaining or improving yield. Gypsum as a soil amendment has not been well studied in Illinois. Study

results will confirm or limit the applicability of the recent, June 2016, NRCS Federal Conservation Practice Standard 333: Amending Soil Properties with Gypsum Products, to southern Illinois.

Specific Objectives:

1. To determine the effect of flue gas desulfurization (FGD) gypsum application rate (1 ton/acre, 3 ton/acre, and 9 ton/acre) on dissolved phosphate leaching from an agricultural field in southern Illinois.
2. To assess the impact of FGD gypsum, calcium, and sulfur additions on corn and soybean yield at a field scale.
3. To determine the impact of FGD gypsum application on soil physical properties: penetration resistance, infiltration, bulk density, and aggregate stability.
4. To assess the economic cost of the gypsum addition and the practicality of farmer adoption through a partial budget analysis.
5. To develop a final report at the conclusion of the project that addresses each of these objectives.

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
Reducing P Loss in Southern Illinois: Producers, Practices, and Productivity	UI	R. Christianson	2018-2021	\$190,147

Objectives:

The major goal of this work is to evaluate, refine, and promote both recommended and novel practices to reduce phosphorus (P) losses in unglaciated areas of Illinois. The practices under evaluation are no till/conservation tillage, cover crops, and edge-of-field P filters.

The specific assessable objectives are to:

1. Install surface runoff monitoring plots to measure runoff and P loss from five infield treatments (Ewing Demonstration Center) and evaluate P loss under both:
 - a. Natural rainfall over four years
 - b. Simulated rainfall events
2. Measure infiltration and water holding capacity as a proxy for runoff (private farms and Ewing Center).
3. Design and construct a novel P-removal filter (On-campus and Ewing Center).
4. Perform rainfall simulations on a cover crop to evaluate runoff and leaching P loss reduction under freeze/thaw conditions (On-Campus).
5. Assess soil P for vulnerability to run-off losses with multiple, complementary measures of P availability and soil loading
6. Perform an economic evaluation and promote these effective P practices.
7. Per the RFP, the final objective is *“to include a final report at the conclusion of this project to address each of the objectives stated above.”*

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
Evaluating slow-release P fertilizers to increase crop production and environmental quality	UI	Margenot	2018-2021	\$56,158

Objectives:

The goal of this work is to evaluate a specific type of slow-release phosphorus (P) fertilizer, struvite, for the specific soil, crop, and management conditions of Illinois production agriculture, in order to identify conditions in which such fertilizers can increase P crop uptake and minimize P losses.

The specific assessable objectives are to:

1. Determine optimum formulations of slow-release P for testing agronomic and environmental potential under field conditions (greenhouse study #1);
2. Compare the agronomic efficiency and off-farm loss risk of slow-release P with soluble P fertilizers across representative management practices (tillage, fertilizer placement) (field trial);
3. Identify potential soil × crop interactions using major soil types of Illinois for corn and soybean (greenhouse study #2);
4. Perform an economic evaluation of conventional and struvite-based slow-release P fertilizers
5. Conduct a literature review on the actual and potential roles of P fertilizer formulation, timing, and placement to help meet agronomic and environmental P management goals;
6. Synthesize results in a final report to address each of the aforementioned objectives, with an emphasis on context-specific management recommendations.

Project Title	Institution	Primary Investigator	Proposed Project Period	2018 Project Budget
On-Farm Evaluation and Demonstration of Reduced Off-Farm Nutrient Transport through Drainage Water Recycling	UI	Cooke	2018-2021	\$130,954

Objectives:

The main goal is to evaluate and demonstrate drainage water recycling as an effective management practice that optimizes crop yield at reduced fertilizer application, enhances nutrient use efficiency by crops, and reduces nutrient (N and P) export to riverine water. The specific objectives are to:

1. Evaluate and identify the BMPs for crop recovery and reuse of nutrients in recycled drainage water, which promote farm income and foster broad adoption of such practices.
2. Assess contributions of drainage water management to nutrient (N and P) use efficiency
3. Evaluate crop response to reduced fertilizer use under sub-irrigation with drainage water
4. Study changes in the physical, biological and chemical properties of soil under intermittent drainage and sub-irrigation.
5. To include a final report at the conclusion of this project to address each of the objectives stated above.