Indiana Corn Marketing Council and Soybean Alliance Research Grant

Final Technical Report

Project Title: Indiana Watershed Initiative (IWI): Quantifying Water Quality Responses from Watershed-Scale Pairing of Cover Cops and Two-Stage Ditch

Grant Period: 1st July 2016 – 30th June 2017

Principal Investigators: Jennifer Tank (University of Notre Dame)

Todd Royer (Indiana University – Bloomington)

Project Overview

The overall aim of this ongoing project is to quantify the water quality and soil benefits from the watershed-scale implementation of winter cover crops and the two-stage ditch in two Indiana watersheds. Funds supplied to farmers in the watersheds (Shatto Ditch and Kirkpatrick Ditch) through the USDA Regional Conservation Partnership Program (2015-2019) have been allocated to enable the widespread planting of cover crops and installation of new two-stage ditch along the stream channels draining each watershed. These Best Management Practices (BMPs) were chosen because they provide a practical solution to nutrient and sediment loss from farmland while maintaining productive and profitable agriculture operations. A key component of our project is accurately documenting the effect of these practices on water and soil quality and estimating the benefits and costs for public and private interests using that information. To that end, we are conducting high resolution monitoring of water and nutrient fluxes, sampling soils, and collecting agronomic data provided by producers and partners. These data are supporting our statewide and regional outreach activities while also providing input for modeling efforts to forecast the effectiveness of these conservation practices at the state and regional scale.

BMP Overview

During this grant period, each watershed contained ~0.5 miles of two stage ditch. In Shatto Ditch Watershed (SDW) the amount of cover crop planting was increased from 12% of the watershed cropland in Fall 2012 to 67% in 2013, and has remained at 60-70% each Fall since (see Figure 1). Kirkpatrick Ditch Watershed (KDW) is our newer research watershed; it expands the geographic scope of the project and provides a point of comparison with SDW. In Fall 2014, only 5% of KDW cropland was planted with cover crops. The plan is to increase this percentage incrementally. The percentage planted in Fall 2015 and Fall 2016 (during this grant period) was 23% and 24% respectively.

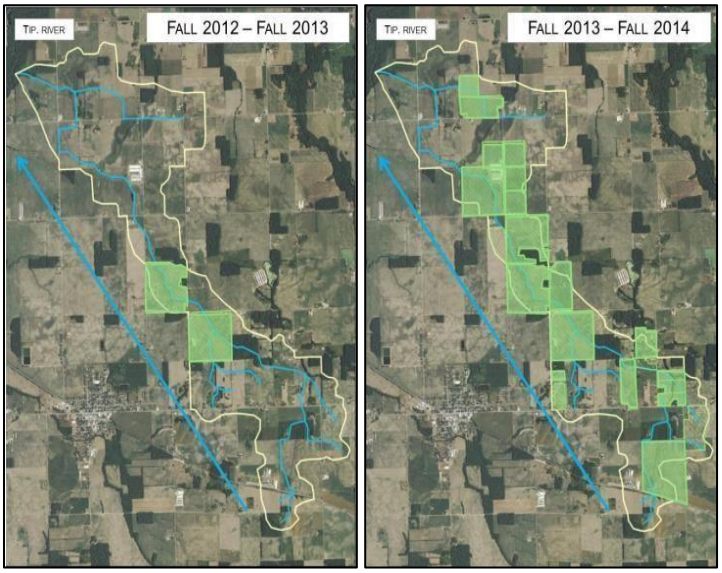

Figure 1. Location of cover crop parcels (shaded in green) in the Shatto Ditch Watershed during the pre-treatment year (left-2012-2013) and Year 1 (Right-2013-2014, with similar coverage each subsequent Fall).

Project Objectives

1. We will quantify the water quality and quantity benefits of pairing cover crop and the two-stage ditch implemented at the watershed scale, through monitoring of the Shatto Ditch Watershed (SDW) located in Kosciusko County (3300 acres) and Kirkpatrick Ditch Watershed (KDW) in Jasper, Newton and Benton Counties (6373 acres).

2. We will quantify the benefits of winter cover crops in improving soil health through increased nutrient retention as well expected improvements of soil organic matter content over four years.

3. With our partners at the USDA Agricultural Research Service (ARS), we will use the process-based Soil Water Assessment Tool (SWAT) model to predict the benefits of watershed-scale cover crops and the two-stage ditch implemented across other watersheds in the region.

4. We will quantify the economic benefits for producers and the environment of the watershed-scale implementation of the cover crop/two-stage ditch pairing including the ecosystem service of increased watershed nutrient retention as well as the costs and benefits to the producers.

These objectives apply to the entirety of the ongoing project, known as the Indiana Watershed Initiative. The research grant from Indiana Corn Marketing Council and Indiana Soybean Alliance during this grant period was used to support activities under all four objectives.

Objective 1: Actions and Outputs

Actions

In order to quantify the water quality and quantity benefits of cover crop and two-stage ditch implementation, we have continued to use a combination of measurement and monitoring techniques and tools. In both watersheds this monitoring was the continuation of work begun with previous grants, including a grant from Indiana Corn Marketing Council and Indiana Soybean Alliance that ran from July 2015 to June 2016.

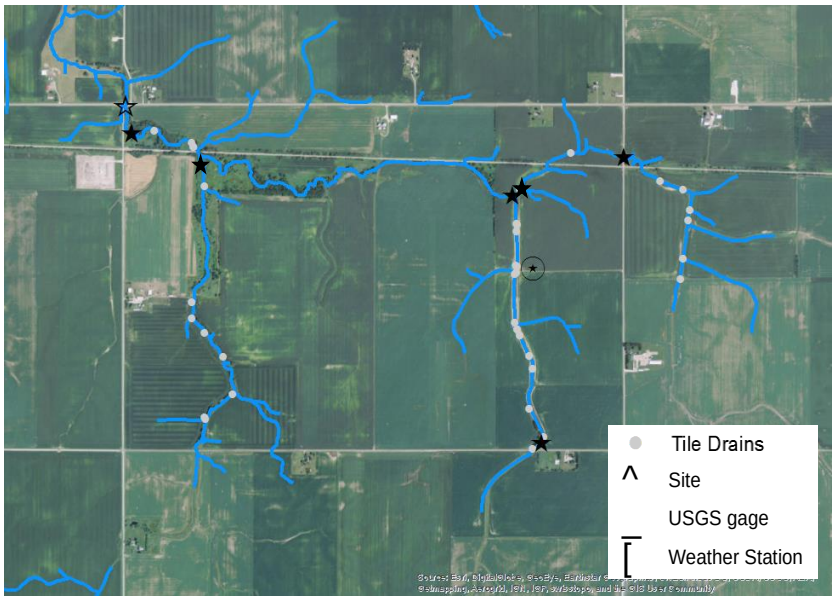

Figure 2. Kirkpatrick Ditch with tile drain and USGS gage locations.

Our sampling teams visited each watershed every two weeks for the entire reporting period. In SDW we continued to monitor 10 in-stream sampling locations and a representative subset of 25 tile drain outlets. In KDW we continued to monitor six in-stream sampling locations and 38 tile drain outlets distributed across ~10 fields (see Figure 2). We collected water samples from these sites and we also measured stream and tile drain flow and other water quality parameters (e.g. pH, conductivity). We then analyzed water samples for the following nutrients: ammonium (NH_4^+), nitrate (NO_3^-), soluble reactive phosphorus (SRP), and dissolved organic carbon (DOC). We continued to collect data from the real-time sensors and gauges deployed in the previous year (USGS stream gauges at the outlet of each watershed and weather stations in each watershed) and in August 2016 we deployed a real-time SUNA nitrate sensor at the outlet of each watershed.

In addition, we carried out habitat surveys in SDW in Fall 2016 and Spring 2017. The habitat survey data has been compared against historical data and has shown an improvement in benthic habitat quality since the introduction of the two-stage ditch. We also carried out habitat surveys in KDW in Fall 2016 and this will become an annual occurrence. These will allow us to assess the impact of our project work on geomorphology and biodiversity as well as water quality.

Colleagues at Grace College and USDA ARS (Agricultural Research Service) have provided us with datasets from other geographically close watersheds which have not had focused efforts on BMP implementation. We have been using these as references to compare to our Shatto and Kirkpatrick datasets and this will help us corroborate that the beneficial changes we are seeing are occurring because of the BMPs rather than as a result of other factors.

Outputs

The outputs of our activities include a wealth of data that enable us to empirically demonstrate the impacts of the BMPs on water quality and quantity.

Shatto Ditch Watershed Results

Nitrate (NO_3^-) in stream and tile drains

- Average NO_3^- concentrations from tile drains with cover crops in all years of monitoring in SDW are lower than tile drains without cover crops in the year before cover crop saturation (2012-2013) (Figure 3).
- Average seasonal NO_3^- flux from tile drains with cover crops in all years show a similar pattern with the most notable reductions during spring.

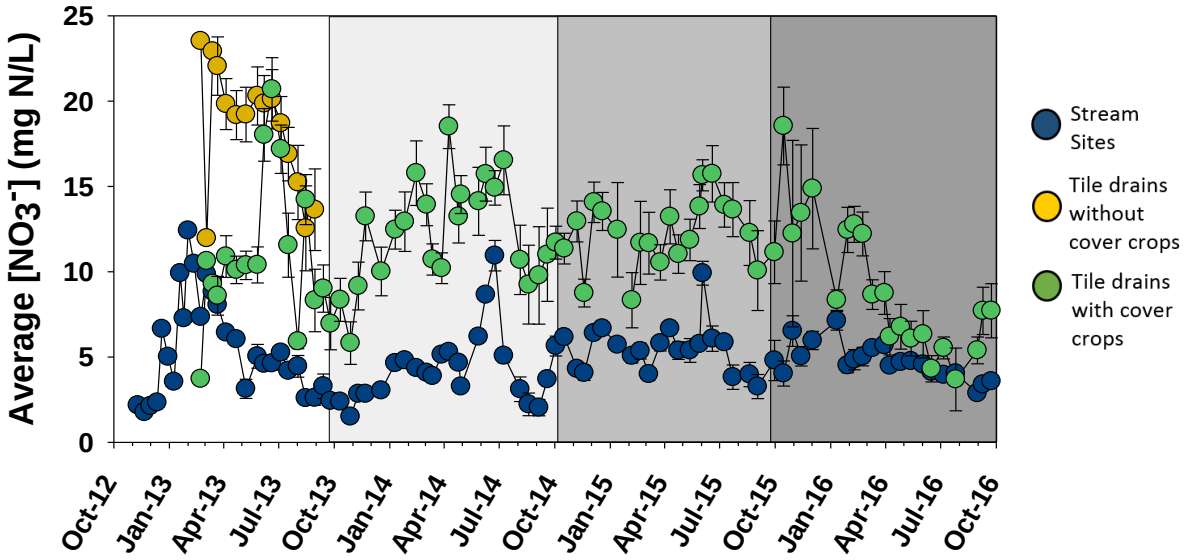

Figure 3. SDW tile drain NO_3^- concentrations have been lower since saturating the watershed with cover crops in October 2013 and in spring/summer 2016 the tile drain NO_3^- concentrations were almost as low as the stream NO_3^- concentrations.

Storm nutrient export (Figure 4)

- We have quantified N and P export during storm events, which has been a “frequently asked question” during many of our presentations. We found that storms do contribute significantly to N and P export; however, cover crops greatly reduced the amount of N and P export during winter and spring storms.
- Based on these results, we have targeted storms for sampling with ISCO automated samplers at the base of each watershed to capture both NO_3^-, SRP, total phosphorus (TP), and turbidity (Figure 4). One storm, from April 5, 2017 in SDW shows different patterns between SRP and NO_3^-, with SRP concentrating while NO_3^- diluted. Also during this storm TP was highly correlated with turbidity. We will continue targeted sampling during selected storms in both watersheds across seasons, including with and without cover crops.

Total watershed nitrate (NO_3^-*) export*

- We completed analysis of watershed NO_3^- export for the 2013, 2014, 2015, and 2016 water years in SDW, using water chemistry and stream discharge data.
- NO_3^- export was 1% lower in 2015 and 2016 compared to 2013 despite having 8% and 16% higher runoff (see Table 1 below).

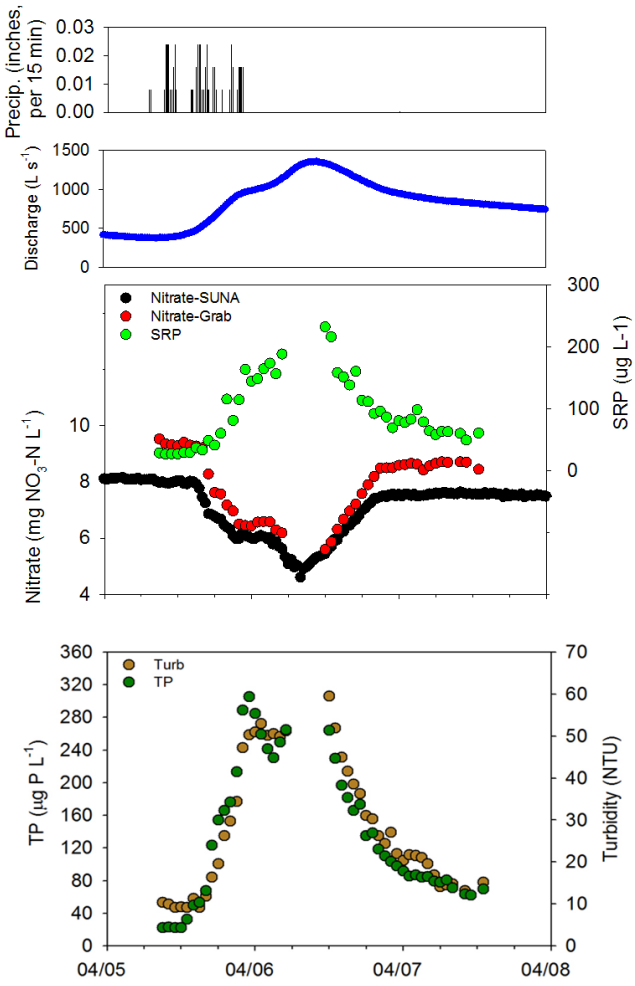

Figure 4. Precipitation, stream discharge and grab samples of SRP, NO_3^-, TP, and turbidity collected at the base of SDW from a storm event on April 5, 2017.

Water Year	Precipitation (mm)	Total Runoff (mm)	Nitrate Export (kg ha^{-1})
2013	1162	270	17.95
2014	942	250	14.64
2015	944	292	17.72
2016	949	314	17.82

Table 1. SDW nitrate export was lower in 2015 and 2016 despite higher runoff, indicating that more nitrate is being held in the watershed than before widespread cover crop planting

Additional Research Plans

- Stream nitrate concentrations in SDW have decreased, but not as significantly as tile drain nitrate has decreased. We hypothesize that this is due to the contribution of nitrate-rich groundwater and we have collected groundwater samples for “isotope aging” and have sent these samples off for analysis to address this question.

Kirkpatrick Ditch Watershed Results

Nitrate trends in tile drains (Figure 5)

- Nitrate concentrations vary throughout the year but tend to be highest in spring/early summer.
- In 2016, tile drain nitrate concentrations were lower under cover crops, particularly during spring. In May 2016, the tile trains under cover crops had almost half the nitrate concentration of tile drains without cover crops.

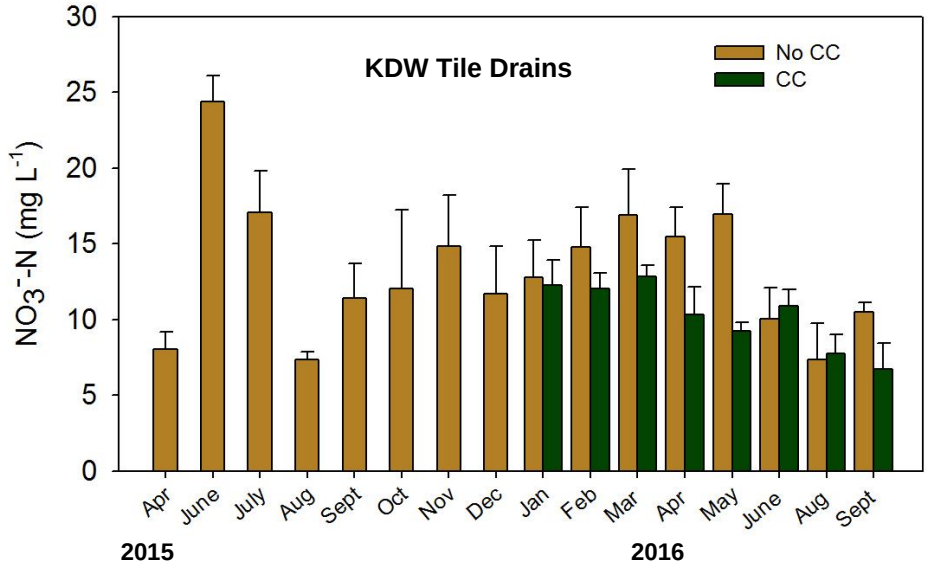

Figure 5. KDW tile drain nitrate tends to be highest in spring/early summer but in 2016 the nitrate concentrations of tile drains under cover crops was lower.

Phosphorus trends in tile drains (Figure 6)

- Soluble Reactive Phosphorus (SPR) was variable in 2015. Results from 2016 show less variable SRP and similar concentrations in the tile drains both with and without cover crops.

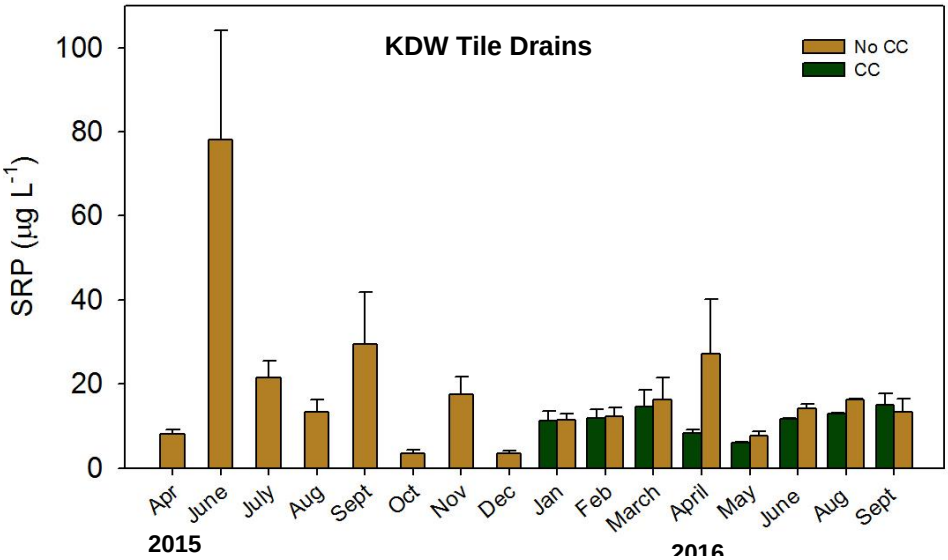

Figure 6. KDW tile drain phosphorus is variable and concentrations were similar in 2016 with and without cover crops.

Nitrate trends in the stream, with SDW stream data for comparison (Figure 7)

- Both watersheds show seasonal trends in stream nitrate concentrations, with concentrations generally highest in the spring.
- KDW has higher stream nitrate than SDW but the peak spring nitrate concentrations were lower in 2016 (after 23% watershed had cover crop planting) than in 2015.

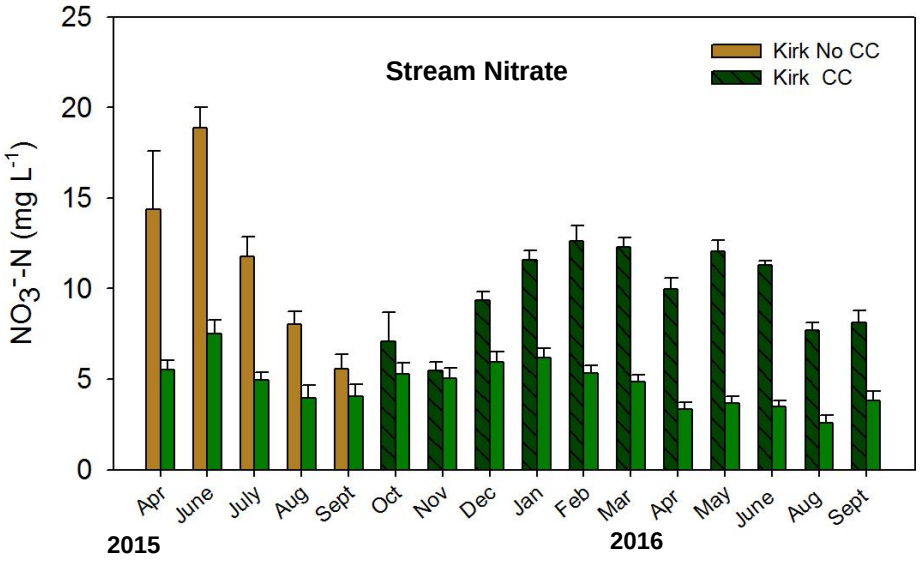

Figure 7. Both watersheds show seasonal trends in stream nitrate concentrations, with KDW having higher concentrations than SDW.

Soluble Reactive Phosphorus trends in the stream, with SDW stream data for comparison (Figure 8)

- Stream dissolved phosphorus was variable in both watersheds in 2015.
- In 2016, dissolved phosphorus was lower and more consistent in both watersheds.
- Dissolved phosphorus concentrations in SDW are generally higher than in KDW.

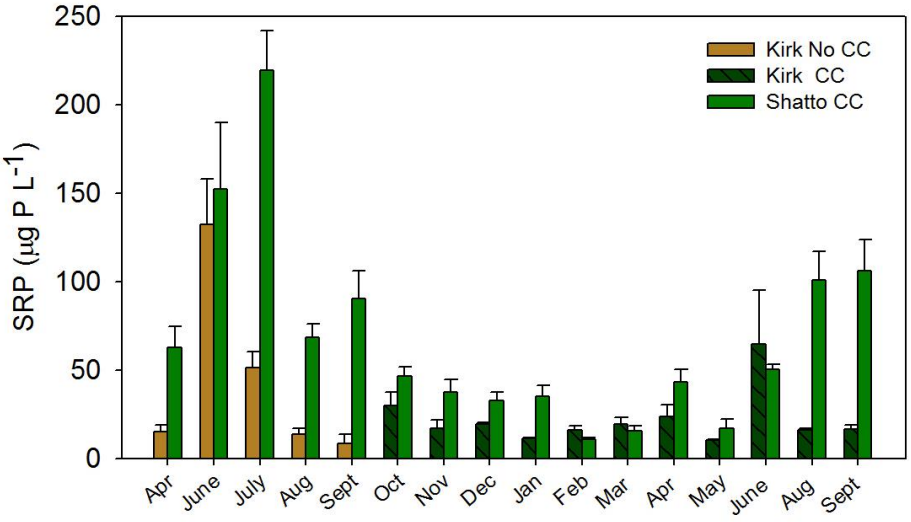

Figure 8. Stream dissolved phosphorus is variable in both watersheds, with lower concentrations in KDW.

Objective 2: Actions and Outputs

Actions

In order to assess the changes in soil health from the planting of cover crops, we continued our soil sampling schedule by conducting soil surveys in Fall 2016 and Spring 2017 in both watersheds. In SDW we sampled 10 fields with cover crops and 3 fields without; in KDW we sampled 3 fields with cover crops and 4 fields without. Within each field we sampled soil along three transects that were perpendicular to the tile drain outlet (~ 20, 40, and 60 m from the edge of the field) as well as three transects parallel with the tile drain outlet. We collected soil at 0-5 cm and 5-20 cm depths at 6 points along transects and homogenized 2 samples per transect from each depth and each field for a total of 12 samples per field. Samples were analyzed for dry bulk density, pH, soil moisture, organic matter content, and total P. We also measured soluble species of Mehlich III phosphorus, water extractable phosphorus, soil nitrate-N, ammonium-N, and total dissolved N. For statistical analysis, we performed a randomized analysis of variance (ANOVA) to test the hypothesis that differences in nitrogen and phosphorus were due to differences between treatments (cover crop versus no cover crop).

Outputs: Soil results from both watersheds

Cover crops are reducing soil nitrate loss in both watersheds (Figure 9)

- We found that soil NO_3^-N at both depths (0-5 cm and 5-20 cm) was lower in cover crop fields compared to those without cover crops (Figure 9, ANOVA, p=<0.05) in Fall 2013, 2014, and 2015, as well as Spring 2014, 2015, and 2016, suggesting that N may be tied up in cover crop tissue during Fall and Spring.
- In addition, buried bags tests have indicated that soil nitrification and mineralization is significantly higher in soils with cover crop residues (ANOVA, p<=0.05).
- We also found that water extractable P was lower in cover crop fields compared to non-cover crop fields, though these results were not statistically significant.

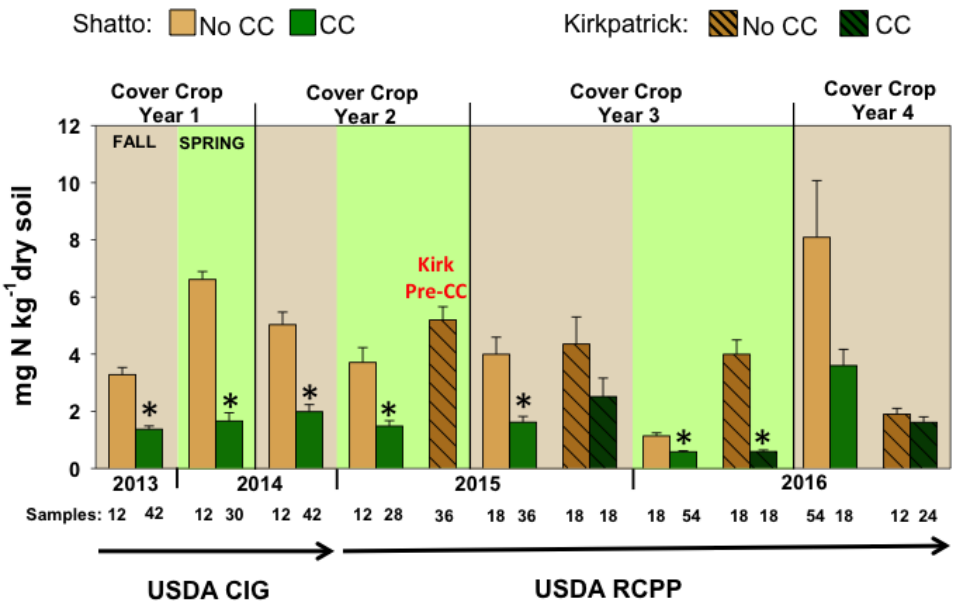

Figure 9. KDW and SDW soil nitrate. Soil nitrate-N concentrations at the 0-5 cm depth were significantly lower in cover crop fields than those without cover crop during both Fall and Spring sampling over 3 years. Asterisk within season indicates a significant difference when p< 0.05.

Cover crops may be increasing soil organic matter (Figure 10)

- Cover crops did not increase soil organic matter in first 2 years of the study in SDW (0-5 cm and 5-20 cm depths) but organic matter did increase under cover crops in KDW in Fall 2015 and Spring 2016. (ANOVA, p=<0.05)

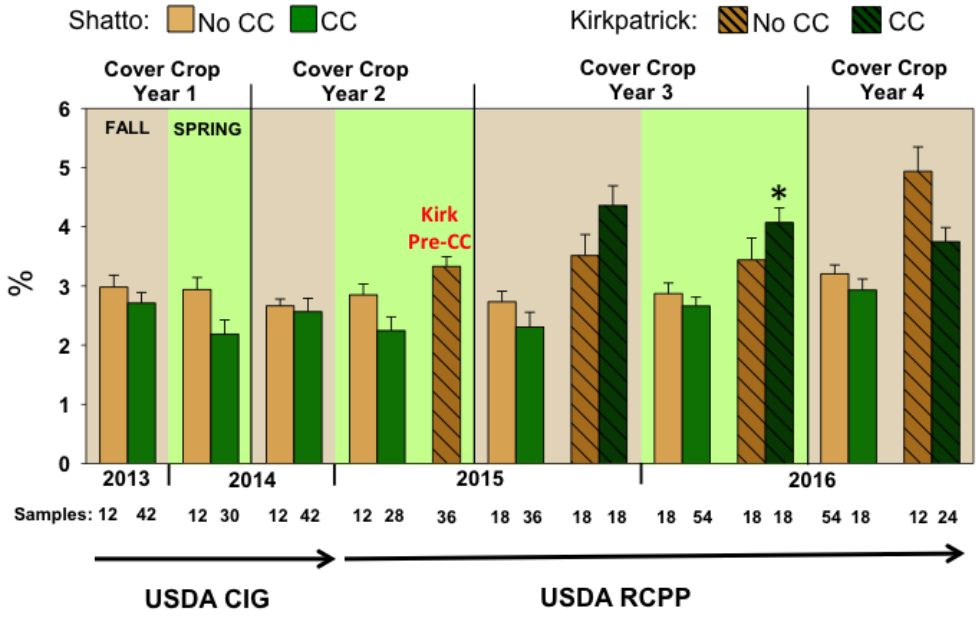

Figure 10. KDW and SDW soil organic matter. Cover crops did not increase soil organic matter in first 2 years of the study in SDW but organic matter did increase under cover crops in KDW in Fall 2015 and Spring 2016. Asterisk within season indicates a significant difference when p< 0.05.

As with the water results, the outcome of these results is that we are able to contribute further data to understanding how cover crops retain nutrients in the field and return them to the soil after termination, thereby reducing the loss of nutrients through tile drains and the impact of agriculture on the environment.

Objective 3: Actions and Outcomes

We have been working on ways to predict the wider impacts of both cover crops and the two-stage ditch using the Soil Water Assessment Tool (SWAT), a widely-used model that predicts water quality responses to agricultural land management activities. With SWAT, we can scale-up our results to address regional-scale questions, test various scenarios, and generate new hypotheses.

To parameterize the SWAT model for both the cover crop and two-stage ditch analysis, we have collated and processed field data derived from SDW and KDW to be used for calibration and validation. We have also reconditioned digital elevations models (DEMs) and prepared soils data and land use coverage data. The soil and land use data was first used for input to the Agricultural Conservation Planning Framework (ACPF) tool, which is used to assess nitrate leaching and runoff risk. We used the tool to evaluate the nutrient reduction potential of various SDW land use scenarios (including current cover crop coverage) and estimate annual cost across a series of cover crop scenarios. The scenarios from this tool are used as input to the SWAT model.

In addition, for the two-stage ditch component, we have worked with partners at the USDA Agricultural Research Service (ARS) to develop a new module for the SWAT model (there was no pre-existing two-stage ditch module). This module predicts nitrate and total phosphorus reduction resulting from two-stage ditches. Data from 9 Midwestern two-stage ditches were used for the module creation phase. Our team submitted a manuscript describing some of this work to the journal Ecological Engineering, entitled “Modeling nutrient removal using watershed-scale implementation of the two-stage ditch”. The article was accepted in March 2017 and is now available online at http://www.sciencedirect.com/science/article/pii/S0925857417301581.

The modeling component of our project is being fed directly into the economic analysis because the model simulations are used as factors in this analysis. Future SWAT model simulations will allow for more refined analysis, determination of cost-effectiveness evaluations relative to nitrate and sediment reductions, and incorporation of aggregative field-level net profitability data. We will conduct further ACPF and SWAT analyses in both watersheds.

Objective 4 Outputs and Outcomes

Our final objective is to quantify the economic benefits, for both producers/land managers and the environment, of the watershed-scale implementation of the cover crop/two-stage ditch pairing, including the ecosystem service of increased watershed nutrient retention as well as the costs and benefits to the producers. In order to expand our capacity and expertize in this area, Dr. Adriana Valcu-Lisman joined our team in January 2017, working with Dr. John Tyndall at Iowa State University. Dr. Valcu-Lisman is an environmental and natural resource economist.

Deriving a benefit-cost ratio requires an economic valuation of the benefits and costs. The costs of the practices are a known value in this project. The primary benefits include avoided fertilizer loss and prevented water pollution, which is being measured under Objective 1. Another potential benefit of cover crops is improved soil quality and increased crop yield. Soil data is being collected under Objective 2 but information on soil changes can also be obtained directly from producers. The other key information required is the land managers’ costs and returns associated with their farm management practices including their use of cover crops. Survey data collected from SDW land owners/producers in previous years has been used for preliminary analysis but we have also been making the necessary preparations for conducting a new survey, written specifically to collect the essential data needed for our economic analyses and guided by the experience of our Iowa State University team members. This survey was distributed in August 2017 and will allow us to estimate direct, indirect and opportunity costs for producers associated with cover crop/two-stage ditch pairing. The survey is attached in Appendix 1.

The modelling work described under Objective 3 is a key part of the economic analysis because the models are used to simulate various watershed scenarios, setting up the environmental context of the analysis. Farm-scale (e.g., field-level nutrient retention and reduced erosion) and watershed benefits (e.g., reduced nutrient transport and sedimentation), as characterized by SWAT modeling, are being framed in economic terms and monetized. This work will continue through the next phase of the project.

Project Outreach

Project team members have continued to engage in a wide variety of outreach events and activities including giving presentations at agricultural meetings, academic conferences and farmer outreach events such as field days; hosting watershed tours; and participating in educational events and webinars. These are opportunities to share our preliminary findings with the agricultural and scientific community and also the public. Highlights have included invited talks at the American Geophysical

Union Chapman Conference on Extreme Climate Event Impacts on Aquatic Biogeochemical Cycles and Fluxes, Puerto Rico, and at the Association for the Sciences of Limnology and Oceanography 2017 Aquatic Sciences Meeting in Hawaii; as well as the November 2016 Notre Dame Shamrock Series Lecture in San Antonio, Texas. Project PI Jennifer Tank also chaired a special session on "Quantifying water quality outcomes of watershed-scale conservation projects" at the Universities Council On Water Resources Annual Conference in Colorado in June 2017, at which all of the project graduate students presented project data. We also continue to maintain our online presence via our website and social media accounts which provide a place to share results, updates and project resources e.g. one-page data summaries. An outreach summary is provided in Table 2 and a full list is provided in Appendix 2.

Led by PhD student Brittany Hanrahan, we have been preparing a manuscript describing the first 4 years of stream and tile drain results from the SDW for submission to Environmental Science & Technology, hoping to reach a large, international audience in this high-impact journal. A new manuscript describing our work on creating a new two-stage ditch module for the SWAT model (using data from this project for calibration) has been accepted by Ecological Engineering and should be in press in the next few months. In addition, Sheila Christopher is working on a manuscript describing the changes we have measured in watershed soils as a result of cover crop planting.

We continue to have open dialogue between the County Soil and Water Conservation Districts (in each watershed), the Nature Conservancy, and the University of Notre Dame, Indiana University and Iowa State University researchers, which is essential for the success of conservation practice implementation and data collection.

Outreach Events/Activities	Total This Reporting Period
All	**47**
Agricultural Meetings	**2**
Farmer Outreach	**6**
Hosted Tours	**3**
Presentations	**29**
Communications & Media	**4**
Other	**3**

Table 2. Summary of Outreach Events and Activities

APPENDIX 1 – 2017 FARMER SURVEY, provided in separate attachment

APPENDIX 2						
CATEGORY	**TITLE/DESCRIPTION**	**DATE**	**LOCATION**	**TEAM ATTENDEE(S)**	**AUDIENCE**	**TALK TITLE**
Presentations	Earth Day Every Day	7/18/2016	St Patrick's County Park, IN	Elizabeth Willows; Matthew Trentman	46 teachers and teaching students	Watershed Research at Notre Dame
Communications and Media	Indiana Watershed Initiative website and Twitter and Facebook accounts launched	7/19/2016			Unlimited online audience	
Farmer Outreach	Field to Lake: Soil, Science and Water Working Together Field Day	7/27/2016	Near Napoleon, Henry County, OH	Brittany Hanrahan; Elizabeth Willows	30 farmers, water and soil scientists and conservation organization staff	Reducing nutrient loss with the two stage ditch and cover crops
Agricultural Meetings	North American Manure Expo	8/3/2016	London, OH	Matthew Trentman	~40 people; mostly producers, but also some Ohio State extension people	Can watershed-scale cover crops reduce nutrient export?
Presentations	National Non-point Source Pollution Workshop	8/22/2016	Salt Lake City, UT	Matthew Trentman	Approximately 120; mostly government and non-profit employees, some researchers	Can Changes in Land Cover and Floodplain Connection Alter Nutrient Export from Agricultural Watersheds?
Hosted Tours	Hosted Illinois Soybean Association board members in Shatto Ditch	8/24/2016	Shatto Ditch Watershed, Mentone, IN	Jennifer Tank; Brittany Hanrahan; Elizabeth Willows	8 board members, 4 SWCD & NRCS partners	Overview of Indiana Watershed Initiative project
Farmer Outreach	Farming for the Future; Healthy Soils Field Day	8/25/2016	Solid Rock Farms, Remington, IN	Elizabeth Willows; Brittany Hanrahan	28 farmers, 3 SWCD partners, 1 SHP rep	Update on Indiana Watershed Initiative Project
Presentations	EcoSummit Meeting	8/31/2016	Montpellier, France	Jennifer Tank	Talk audience: 250. Meeting attendees: 1800	Can floodplain restoration alter nutrient export from agricultural watersheds?
Presentations	Indiana Association for Floodplain and Stormwater Management	9/9/2016	Belterra Resort, Florence, IN	Jennifer Tank	280 researchers and industry professionals	Floodplain restoration via the two-stage ditch alters nutrient export from

						agricultural watersheds
Farmer Outreach	Scott's Cover Crops Fall 2016 Cover Crop Field Day	9/20/2016	Pierceton, IN	Elizabeth Willows; Shannon Speir; Anna Kottkamp	60 farmers and SWCD/NRCS/agricultural organization attendees	
Other	Science Sunday	9/25/2016	Notre Dame Linked Environmental Ecosystem Facility	Elizabeth Willows; Sheila Christopher; Shannon Speir	>170 members of the public, all ages	
Agricultural Meetings	Fertilizer Research Workgroup	9/30/2016	Michigan State University, MI	Jennifer Tank	18: scientists, state-level ag/conservation workers and fertilizer industry representatives	
Hosted Tours	Kirkpatrick Site Visit for the Upper Thames River Conservation Authority (Canada)	10/18/2016	Kirkpatrick Ditch Watershed, IN	Matthew Trentman; Shannon Speir; Kara Prior; Ursula Mahl; Erik Maag (undergraduate); Dan Perkins; other members of Jasper Co. Soil and Water Conservation District	6 watershed managers from Canada	
Presentations	International Water Association (IWA) Regional Conference on Diffuse Pollution and Catchment Management	10/24/2016	Dublin City University, Dublin, Ireland	Brittany Hanrahan	30 researchers	Can changes in floodplain connection and land cover alter nutrient export from agricultural watersheds?
Farmer Outreach	Farming for the Future	11/3/2016	Brook, IN	Jennifer Tank; Todd Royer; Kara Prior; Matthew Trentman; Shannon Speir; Ursula Mahl; Elizabeth Willows	140: mostly farmers plus SCWD workers and ag industry representatives	Indiana Watershed Initiative Project Update

Presentations	The American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America 2016 Annual Meeting	11/8/2016	Phoenix, AZ	Sheila Christopher	50 researchers and agriculture industry representatives	Linking soil health to improved water quality via the planting of cover crops in the Shatto Ditch Watershed, Kosciusko Co, IN
Presentations	CAST, Science Teachers Conference	11/11/2016	San Antonio, TX	Jennifer Tank	150 teachers	Fighting for farmers and freshwater
Presentations	Shamrock series lecture	11/11/2016	San Antonio, TX	Jennifer Tank	1600 middle school students	Fighting for farmers and freshwater
Other	New publication in Agricultural Water Management journal, co-authored by Sheila Christopher and Jennifer Tank	12/1/2016	http://www.sciencedirect.com/science/article/pii/S0378377416303961			Title: A synthesis and comparative evaluation of factors influencing the effectiveness of drainage water management
Communications and Media	Webinar entitled Linking BMP and Water Quality Success in Indian Creek Watershed (related to RCPP watershed work)	12/8/2016		Ursula Mahl	78 online audience (mostly producers)	
Presentations	American Geophysical Union Chapman Conference on Extreme Climate Event Impacts on Aquatic Biogeochemical Cycles and Fluxes	1/26/2017	San Juan, Puerto Rico	Jennifer Tank	100 academics (including graduate students) and USGS and EPA staff	Watershed-scale conservation, through changing land cover, reduces nutrient export from agroecosystems even under changing hydrology
Presentations	Purdue University Forestry and Natural Resources Seminar Series	1/31/2017	Purdue University, IN	Jennifer Tank	150 graduate students and academic researchers	
Presentations	Fulton County (IN) Soil and Water Conservation District Annual Meeting	2/6/2017	Rochester, IN	Jennifer Tank; Elizabeth Willows	84 farmers and SWCD members	Indiana Watershed Initiative Project Overview
Other	Visit with senior Penn High School students to give guidance on an water quality project	2/16/2017	Penn High School, South Bend	Elizabeth Willows	4 senior students and 1 teacher	

Presentations	Jasper County Soil and Water Conservation District annual meeting	2/28/2017	Rensselaer, IN	Elizabeth Willows; Matthew Trentman; Shannon Speir; Kara Prior; Ursula Mahl	90 farmers	Indiana Watershed Initiative Project Update
Presentations	Association for the Sciences of Limnology and Oceanography 2017 Aquatic Sciences Meeting - Mountains to the Sea	3/1/2017	Honolulu, Hawaii	Jennifer Tank	100 academics and natural resource managers	Watershed-scale land cover change alters stream ecosystem function and reduces nutrient export from agricultural landscapes
Presentations	Rotary World Affairs Conference - Water: Keeping It Safe	3/17/2017	Indiana University South Bend	Elizabeth Willows	45 high school students and teachers	Investigating the Impacts of Agricultural Conservation Practices on Water Quality
Communications and Media	Publicity article for a meeting on “Preventing Nutrient Loss from Farms” at which Jennifer Tank was an invited speaker	3/17/2017	http://kpcnews.com/business/latest/kpcnews/article_e6553299-4975-5a72-928a-4d7abd1880f0.html			
Presentations	Rotary Club of Elkhart	3/27/2017	Elkhart, IN	Jennifer Tank	150 rotary club members and guests	Indiana Watershed Initiative
Hosted Tours	Indiana Watershed Initiative tour for Walton Family Foundation	3/29/2017	Shatto Ditch Watershed, IN	Jennifer Tank; Todd Royer; Darci Zolman	11 members of Walton Family Foundation	Indiana Watershed Initiative
Presentations	Reducing Nutrient Loss event	3/30/2017	Bryan, OH	Jennifer Tank; Elizabeth Willows	37 farmers and SWCD members	Indiana Watershed Initiative
Presentations	Kent State University Biological Sciences Seminar Series	4/14/2017	Kent State University, OH	Jennifer Tank	100 university students and academics	Changes in watershed land cover and floodplain connection reduce nutrient export from agroecosystems
Presentations	Good Shepherd Montessori School Junior High Academic Conference	5/5/2017	South Bend, IN	Jennifer Tank	30 junior high students	

Communications and Media	Webinar: Water Quality Targeting Success Stories Report Launch	5/24/2017	Washington DC and https://www.farmland.org/initiatives/water-quality-targeting-success-stories	Jennifer Tank	245 (online and in-person at launch event)	
Presentations	Society for Freshwater Science annual meeting	6/5/2017	Raleigh, North Carolina	Shannon Speir	110	Real-time nitrate data provide insights into nitrate-n export during storms in two contrasting agricultural watersheds
Presentations	Society of Wetland Scientists Annual Conference	6/6/2017	Puerto Rico	Sheila Christopher	50	Modeling nutrient removal using watershed-scale implementation of the two-stage ditch
Presentations	Society for Freshwater Science annual meeting	6/7/2017	Raleigh, North Carolina	Brittany Hanrahan	100	Comparing denitrification rates between restored and naturalized floodplains in agricultural ditches
Presentations	Society for Freshwater Science annual meeting	6/8/2017	Raleigh, North Carolina	Anna Kottkamp	100	Changes in benthic substrate in response to the restoration of inset floodplains in a midwestern agricultural stream
Presentations	Society for Freshwater Science annual meeting	6/8/2017	Raleigh, North Carolina	Jennifer Tank	120	Quantifying water quality benefits of floodplain restoration in agricultural streams at both the reach- and watershed-scale
Presentations	Universities Council on Water Resources 'Water in a Changing Environment' conference	6/14/2017	Fort Collins, CO	Brittany Hanrahan	40	Quantifying changes in nutrient export from an agricultural

						watershed following the planting of winter cover crops
Presentations	Universities Council on Water Resources 'Water in a Changing Environment' conference	6/14/2017	Fort Collins, CO	Ursula Mahl	40	Linking soil health to improved water quality via the planting of cover crops in two Indiana watersheds
Presentations	Universities Council on Water Resources 'Water in a Changing Environment' conference	6/14/2017	Fort Collins, CO	Kara Prior	40	Response in dissolved organic carbon dynamics and greenhouse gas emissions to watershed-scale implementation of winter cover crops
Presentations	Universities Council on Water Resources 'Water in a Changing Environment' conference	6/14/2017	Fort Collins, CO	Shannon Speir	40	Real-time monitoring provides insight into nitrate-n export during storms in two agricultural watersheds
Presentations	Universities Council on Water Resources 'Water in a Changing Environment' conference	6/14/2017	Fort Collins, CO	Matthew Trentman	20 academics	Comparing the effectiveness of increased winter land cover on nutrient export across two Indiana agricultural watersheds
Farmer Outreach	Shatto Ditch Watershed Annual Town Hall meeting	6/26/2017	Mentone, IN	Jennifer Tank; Todd Royer; Kara Prior; Matt Trentman; Shannon Speir; Elizabeth Willows	16: 2 SWCD partners, 1 NRCS partner, 1 County Surveyor, 1 TNC partner, 11 landowners	IWI RCPP Project: Shatto Ditch Update
Farmer Outreach	Kirkpatrick Ditch Watershed Annual Town Hall meeting	6/27/2017	Goodland, IN	Jennifer Tank; Todd Royer; Kara Prior; Elizabeth Willows;	11: 3 SWCD partners, 2 NRCS DCs, 1 TNC partner, 3 farmers, 2 county surveyors	

				Shannon Speir; Matt Trentman		
Presentations	Indiana Water Resources Association Symposium	6/29/2017	Turkey Run State Park, IN	Elizabeth Willows	72	Successes and challenges in quantifying the impact of watershed-scale conservation on working land