Iowa Nutrient Research Center projects approved for funding in 2016 (FY2017)

Improving the capacity to detect load reductions. Castellano, M., A. Sotirios, B. Crumpton, M. Helmers, C. Jones, F. Miguez, K. Schilling

Objectives: To improve our capacity to detect load reductions, we will achieve two main objectives:

1. We will improve N budgets by linking field measurements of corn grain N concentration, soybean grain N concentration, and soybean N fixation to the APSIM process-based cropping systems model.
2. We will incorporate spatiotemporally explicit model outputs into regression (statistical) models of nitrate load and flow-weighted concentration.

Potential Monomethylmercury Production in Bioreactors and Wetlands Intercepting Elevated Nitrate Loads in Iowa. Crumpton, W., M. Soupir, C. Judge

Objectives: The overall goal of this study is to evaluate the net production of MeHg in woodchip bioreactors and wetlands intercepting tile drainage in Iowa, and to identify system variables that affect MeHg production. This effort would be coordinated with research on the performance of Iowa CREP wetlands and with bioreactor research at the Agricultural Engineering Research Farm west of Ames (in a system of nine bioreactors constructed with funding from the INRC in 2013). Samples would be analyzed for MeHg and THg through a collaborative agreement with the USGS Mercury Research Lab in Madison, Wisconsin. Sampling design will encompass seasonality of MeHg production and results will be analyzed in conjunction with measurements of nitrate removal and GHG emissions on these systems. This work is intended to determine the risk and conditions of MeHg production in these systems and to provide guidance on strategies to optimize nitrate removal while minimizing that risk.

Impacts of prairie pothole hydrology on field-scale losses of nitrogen and dissolved phosphorus. Hall, S.J., A. Kaleita, M. Soupir, A. VanLoocke

Objectives: We propose two years of field observations to assess the impact of pothole depressions on hydrologic and gaseous losses of N and P relative to upland soils, on a site planted with conventional corn (first year) and bean (second year). The PI's have established plots at the ISU-owned Been farm, a site with characteristic pothole topography in close proximity to ISU. The requested NRC funding will leverage ongoing EPA, NSF, and Leopold Center funded research at this site.

1. *Characterize hydrologic N and P losses across pothole to upland topographic gradients* Shallow subsurface zero-tension lysimeters and moisture sensors (50 cm) will be installed at six locations along four replicate transects spanning pothole depressions to well-drained ridgetops in the Been field, which is under uniform cropping management. Lysimeters will be sampled bi-weekly from April to Nov (total n = 384) for analysis of nitrate, total dissolved N and P, and iron in Hall's lab. Leaching fluxes at each topographic position will be calculated as the product of measured concentrations and water infiltration estimated by Kaleita's group using water depth measurements and a hydrologic model.
2. *Characterize gaseous N losses across pothole to upland topographic gradients* We will continue ongoing weekly measurements of soil-atmosphere fluxes of N2O using dynamic chambers at sites spanning the transects described above, supported in part by Hall's startup funds. These measurements will be complemented with monthly measurements of N2 and N2O production from fresh intact soil cores using the acetylene inhibition method. These will be conducted using existing equipment in Hall's lab.

Evaluating the Nutrient Processing Capacity of Roadside Ditches. Schilling, K., M. Streeter, L. Jackson, M. St. Clair

Objectives: The goal of this study is to conduct an assessment of the roadside ditches in an eastern Iowa watershed to assess their water and nutrient processing potential. Specifically, our objectives will be to: 1) quantify the catchment area and land use of the contributing areas draining into roadside ditches; 2) quantify the amount of nutrients (N and P) and carbon stored in roadside ditch soils; 3) measure infiltration rates in selected roadside ditches with diverse roadside vegetation communities; 4) measure groundwater nutrient concentrations in selected roadside ditches; and 5) evaluate the effects of roadside ditches to sequester and process nutrients delivered from contributing agricultural areas.

Phosphorus contributions from eroding Iowa stream banks. Moore, P., T. Isenhart, J. Thomas, K. Schilling, C. Wolter, J. Kovar, R. Schultz, J. Palmer

Objectives: This research will extend recent INRC-funded work in the Onion Creek watershed and establish new measurements in a different landform region in Iowa. The goal in both sites is to quantify the contributions of streambank erosion to watershed P export. Continuing research in the Onion Creek watershed will serve to better quantify poorly-constrained components of the sediment and P budgets, including storage in the stream bed and floodplain. We will also begin new measurements within the Loess Hills and Rolling Loess Prairies ecoregion, evaluating a more scalable method of assessing stream bank contributions combining representative bank material sampling with analysis of high-resolution aerial imagery, elevation data, and an automated measurement of a turbidity proxy for P export. This method has the potential to enable more efficient and widespread assessment of stream bank contributions to P loading across the state and beyond.

Woodchip Bioreactors for Improved Water Quality. Soupir, M. N. Hoover, T. Moorman, T. Isenhart

Objectives: The overall goal of this study is to evaluate NO_3-N fate in woodchip bioreactors over a range of HRTs. To achieve this goal, we propose the following objectives:

1. Evaluate fate and removal of NO_3-N at HRTs of 2, 8, and 16 hrs by monitoring bioreactor influent and effluent for TOC, NO_3^-, NH_4^+, and N_2O solutes and N_2O, CH_4, and CO_2 in the gaseous phase during the initial leaching and steady state periods; and
2. Collect and quantify genes that code for nitrite reductase and nitrous oxide reductase in bioreactor woodchip samples and 16S-rRNA genes for community structure.
3. Conduct push-pull experiments to determine nitrate removal kinetics over a range of influent NO_3-N concentrations and HRTs.

Establishment and Monitoring of Saturated Buffers. Isenhart, T., D. Jaynes

Objectives: To support adoption of saturated buffers as a nitrate management practice within tile-drained watersheds, this project will: 1) establish saturated buffers within watersheds targeted for practice implementation by the Iowa Water Quality Initiative; 2) quantify nitrate loss within these buffers established under a range of conditions; and 3) inform the development of criteria under which saturated buffers would be implemented as a conservation practice.

Land Tenure and Nutrient Management Practices: Identifying Economic Barriers and Incentives for Landowners and Tenants to Meet Growing Soil and Water Conservation Needs. Zhang, W., A. Plastina

Objectives: The **overall goal** of this project is to enhance adoption of nutrient management practices and result in win-win situations for landowners and tenants. We plan to accomplish this by examining the economic incentives of adoption **through two state-wide surveys**. First, we add a special section on land tenure and conservation to state-mandated Iowa Farmland Ownership and Tenure survey. This statewide survey conducted every five years 1982-2012 by phone already provides a wealth of information about landowners across Iowa so it is a perfect vehicle to investigate the role of land tenure on conservation by just adding a special section. Second, we also conduct a similar but separate survey among tenants in Iowa. This project builds on the work led by Plastina, who piloted willingness to pay/accept payments to implement conservation practices among 336 lessors and lessees in Iowa during January-February 2016 and found that lessors and lessees have similar perspectives about the top priority conservation practice in their farms, but have different perspectives on the best landowner-tenant arrangement to implement them.

Building cost-effective prairie for multiple nutrient reduction practices. Dr. Justin Meissen Co-PI: Ashley Kittle

Objectives: For this proposal, we will measure treatment effects on the 2015 research plots at Nashua in August/September 2016 and 2017, collecting similar vegetation measures on the demonstration plantings described above. We will establish one or two new studies no later than fall 2017: appropriate species and planting methods for saturated buffers (Middle Cedar Watershed, location TBD), and for marginal lands with extremely wet and extremely dry soils (Kanawa Research and Demonstration Farm). Specifics of each location will determine whether a complete experiment or side-by-side demonstration is feasible. We will conduct vegetation sampling no later than August-September 2018 and report cost per thousand plants established, species diversity and plant size.

Evaluation of Measurement Methods as Surrogates for Tile-Flow Nitrate-N Concentrations. Sawyer, J., M.J. Helmers

Objectives: Surrogate methods need to be developed that allow evaluation of N management practices that reasonably estimate nitrate-N concentrations comparable to measurement in tile flow drainage. Such surrogate methods would allow many more practices to be evaluated, and within agronomic research evaluating effects on crop production and N use efficiency. If successful, surrogates could be utilized on land that is not suitable for tile drainage, but where ground water recharge supplies water (and potential nitrate-N) to surface water systems.

Iowa Nutrient Research Center Request for Proposals

In January 2016, the U.S. Department of Housing and Urban Development (HUD) awarded $96.9M to Iowa for a statewide watershed improvement program, the *Iowa Watershed Approach (IWA).* The IWA will address issues associated with the devastating and dangerous floods Iowa communities experience year after year.

Three of the goals of the IWA relevant to this RFP are to:

- Reduction of flood risk;
- Improvement in water quality;
- Increased resilience;

Nine distinct watersheds across Iowa will serve as project sites for the IWA: Bee Branch Creek in Dubuque, Upper Iowa River, Upper Wapsipinicon River, Middle Cedar River, Clear Creek, English River, North Raccoon River, West Nishnabotna River, and East Nishnabotna River.

As part of the HUD grant focusing on the Iowa Watershed Approach, funds were allocated to the Iowa Nutrient Research Center to solicit research proposals addressing the three categories identified below. Separate proposals are solicited for each category. Projects should be applicable to the identified watersheds and be replicable across the state. They should address the water quality and nutrient reduction objectives in the context of reduced flooding and watershed resiliency goals of the HUD grant.

Category 1: Develop a framework to monetize the benefits of nutrient-load reducing conservation practices, both as individual practices (e.g. wetlands, ponds) and as "stacked practices." The framework should consider primary on-site and off-site economic benefits of reducing nutrient loads and concentrations in surface water as well as secondary and tertiary benefits such as providing wildlife habitat, ecosystem services, scenic beauty, and other public benefit. Project will include analysis of policy barriers and incentives and alternatives to encourage implementation. Maximum budget considered: $195,000 over 3 years.

Category 2: Develop alternative scenarios for combinations of practices to achieve the Iowa Nutrient Reduction Strategy goals. These scenarios should account for different landform regions in Iowa, providing alternatives for practice adoption based on the latest monitoring data in Iowa to better understand linkages from field-scale, micro-watershed-scale, to HUC 12 scale. Maximum budget considered: $130,000 over 3 years.

Category 3: Determine alternative approaches to incorporate changing hydrologic patterns, driven by changing temperature and precipitation trends, into hydrologic modeling in Iowa for water quantity and quality. Do hydrologic changes from weather, land management, or tile drainage impact nutrient processing and E/ET sufficiently to also impact water quantity and quality. Maximum budget considered: $325,000 over 3 years.

Successful projects will demonstrate a linkage to areas with vulnerable populations, and the results will help researchers refine hydrologic modeling in target watersheds, finesse the best selection of built projects and conservation practices and locations, and monetize the costs and benefits of practices implemented in the target watersheds.

Projects should be completed within 3 years. Proposal are limited to six pages of narrative, budget, budget justification and references may be on additional pages. Proposals are due 5:00 pm August 15. Submit proposals or direct questions to John Lawrence, jdlaw@iastate.edu, 515.294.7801.