

## Five-year NCERA-217 report from 2014 to 2018

**Committee Chair:** Ehsan Ghane

E-mail: [ghane@msu.edu](mailto:ghane@msu.edu)

**Administrative Advisor:** Ramesh Kanwar

E-mail: [rskanwar@iastate.edu](mailto:rskanwar@iastate.edu)

### NCERA-217 Meeting Overview

The 2019 NCERA-217 Annual Meeting was held on June 5 and 6, 2019 in Moorhead, MN. This meeting was held in conjunction with the Agricultural Drainage Management Systems Task Force (ADMS-TF) – Agricultural Drainage Management Coalition (ADMC) meeting. Additionally, a project meeting for those involved in the USDA-NIFA-funded Transforming Drainage project was held on Tuesday, June 4. This report below documents an overview of the meeting, member presentations, accomplishments, and impacts.

*Members Present:* Ramesh Kanwar (IA; Advisor), Jane Frankenberger (IN), Laura Christianson (IL), Ehsan Ghane (MI), Jeff Strock (MN), Matt Helmers (IA), Xinhua Jia (ND), John McMaine (SD), Mohammed Youssef (NC), Dan Jaynes (IA).

*Members Not Present:* Gary Sands (MN), Gary Feyereisen (MN), Kelly Nelson (MO), Eileen Kladvko (IN), William Ford (KY), Larry Goehring (NY), Gary Hawkins (GA), Richard Cooke (IL), Zachary Easton (VA), Aaron Daigh (ND), Tim Harrigan (MI), Robert Evans (NC), Clarence Prestwich (Oregon).

### Research Presentations Overview on Wednesday, June 5, 2019

The research meeting consisted of a morning and an afternoon session of oral presentations. The morning session included 7 presentations given by NCERA-217 members and invited guests.

1- Ted Priester, Red River Basin Commission, presented policy and laws about managing agricultural water in the Red River Basin

2- Kelsey Huber, North Dakota State Water Commission, presented about controlled drainage in North Dakota.

3- Henry VanOffelen, Minnesota Board of Soil and Water Resources, presented drainage law and management in Minnesota.

4- Rob Sip, Director of Red River Watershed Management Board, presented about water management in the Minnesota part of the Red River Basin

5- Chad Engels, Moore Engineering, presented about drainage permitting in the Bois de Sioux watershed district in Minnesota

6- Keegan Kult, Executive Director ADCMC, presented an update about the efforts of ADCMC regarding saturated buffers.

7- Jane Frankenberger presented about the future of the ADCMC and moving forward for future meetings.

During the lunch session, we had the honorable Ed Schafer, former Governor of North Dakota and former US Secretary of Agriculture present about leadership in agricultural water management.

8- Ruth Book, NRCS Illinois State Conservation Engineer, presented about NRCS updates on standards and perspectives

9- Katie Flahive, US EPA, presented updates about upcoming request-for-applications, and other EPA updates.

10- Chris Hay, Iowa Soybean Association, presented about new mechanisms for scaling up drainage management implementation

11- Jeppe Kjaersgaard, Minnesota Department of Agriculture, presented controlled drainage results in the Red River Valley

12- Lindsay Pease, University of Minnesota, presented 40 years of nutrient management results at the Northwest Research and Outreach Center

13- Triven Koganti, Aarhus University (Denmark), presented results from drone flights to detect subsurface drainage pipes.

At 4:30 PM, there was a poster session with 18 posters related to drainage.

### **NCERA-217 Member State-Update Overview on Thursday, June 6, 2019**

The NCERA-217 member presentations began at 8:30 AM on Thursday, June 12, and was moderated by Vice-Chair Ehsan Ghane. The NCERA-217 member presentations consisted of oral presentations in the morning. This session included 8 presentations given by NCERA-217 members and an invited guest.

1- Ehsan Ghane (MI) presented research findings about phosphorus results under free drainage, and the impact of sampling frequency on phosphorus load calculation.

2- Dan Jaynes (IA) presented water quality results from their woodchip denitrification, cover crops, drainage water chemistry, and saturated buffer.

3- Laura Christianson (IL) presented nitrogen loss from unfertilized experimental plots, drainage design, impact of drain-pipe size on sediment loss, cover crops, saturated buffer, controlled drainage impact at subwatershed scale, denitrifying bioreactors.

4- Matthew Helmers (IA) presented the impact of 4R nitrogen management on drainage water quality, impact of fertilizer-application timing on crop yield and water quality, and impact of cover crop of nitrogen uptake.

5- Xinhua Jia (ND) presented the impact of controlled drainage on saline and sodic soils, vertical drainage, impact of drainage on crop yield.

6- Jeffrey Strock (MN) presented nitrogen and phosphorus loss under various agricultural practices, woodchip bioreactor with addition of carbon, cover crops, wetland hydrology and nitrate, and nutrient reduction with a drainage ditch with weirs and orifices.

7- Jane Frankenberger (IN) presented results from the retired DPAC including the impact of controlled drainage on flow, nitrate and phosphorus load, and impact of controlled drainage on crop yield and surface ponding.

8- Rachel McDaniel (South Dakota State University, guest presenter) presented results regarding the impact of lab-scale and field-scale woodchip bioreactors on E.coli and undesirable genes (anti-microbial resistant genes).

## Impact Statements

The current project has developed a number of new practical, affordable, and effective drainage design and management options, all of which reduce nutrient delivery to our nation's waters, while maintaining strong crop productivity. For example, the committee studied the effectiveness of edge-of-field structures across the Midwest, NY, NC, and Canada and worked with USDA-NRCS to establish design standards for these practices (e.g., CPS (Conservation Practice Standards) #554 "Drainage Water Management," CPS #604 "Saturated Buffer," and CPS #605 "Denitrifying Bioreactor"). The importance of these Practice Standards cannot be understated. Each standard details the official federal design specifications required for any cost-shared instance of the given practice. Impressively, this means that the committee's work has informed every single instance of these practices across the country. The existence of these standards means farmers can apply for cost-sharing of these practices, dramatically increasing producer interest. Across the twelve Gulf of Mexico hypoxia states mentioned previously, USDA-NRCS data indicate 32 denitrifying bioreactors and more than 40,000 cumulative acres of drainage water management were implemented between 2011 and 2017. These practices alone have resulted in over 300,000 pounds of nitrate being prevented from entering the Mississippi River during this period; even this is a very conservative estimate that does not include instances of these practices implemented without cost-share funding.

The committee has also studied and promoted in-field practices to reduce nutrient losses, including developing guidelines quantifying the amount of nitrate various land covers such as living mulch, winter cover crops, and perennial grasses prevent from entering drainage systems (e.g., 41, 31, and 72% N loss reduction, respectively). Additional practices include avoiding nutrient applications on wet ground and less than one full day before forecasted rainfall and using lower application rates. This applied research and outreach has importantly led to many of our recommendations being adopted by the Mississippi River/Gulf of Mexico Hypoxia Task Force and by many of the Mississippi basin states in developing individual state strategies for nutrient reduction as required by USEPA (e.g., IA-[plan](#); MN-[plan](#)). Our committee efforts have led the USDA-NRCS to establish the National Ag Water Management (AGWAM) Team to increase the adoption of improved drainage practices with a focus on the Upper Mississippi River Basin, the Great Lakes Basin, and the Red River of the North. In these ways, our work has moved beyond the field to positively influence policy and the adoption of improved practices.

Farmers not only across the North Central Region, but also across the country and world, are now adopting these practices due to our outreach efforts. For example, the development of an automated drainage water control structure is trailblazing the revitalization of controlled drainage in eastern North Carolina. Due to Cornell University's outreach activities, producers, contractors, and confined animal feed operation advisors are paying more attention to vulnerable subsurface drainage outlets and adjusting their manure application methods, rates, and timing accordingly. Furthermore, the drain-spacing calculator that we developed has been used in 44 countries and 36 states, and a recent award-winning booklet ("*Ten Ways to Reduce Nitrogen Loads from Drained Cropland in the Midwest*") has been accessed online more than 2,000 times, since its September 2016 release. The DRAINMOD drainage and water

quality models have been refined and expanded, and are being used by researchers worldwide. These models are also essential tools for assessing climate change adaptation strategies for forests and drained agricultural systems.

## **Outputs in the past five years (2014-2018)**

### **1. Publications**

151 peer-reviewed publications; 125 Extension and non-refereed publications; 329 presentations to farm, research, and state/federal agency audiences.

Three new USDA-NRCS Conservation Practice Standards.

A NRCS-CIG grant to conduct coordinated research across the Midwest on the efficacy of drainage water management with a special section of six papers in the Journal of Soil and Water Conservation in 2012 ([pdf](#)).

### **2. Conferences**

Led development and planning of the Tenth International Drainage Symposium with 250 attendees representing the U.S., Denmark, Canada, Ireland, Finland, Norway, Sweden, Latvia, Lithuania, and the Netherlands; 134 presentations/abstracts (20 posters/59 technical papers), and two field tours. Resulted in publication of 14 papers in special issues of the Transactions of the ASABE and Applied Engineering in Agriculture.

### **3. Awards**

National ASABE extension excellence awards for *“Drainage Water Management for the Midwest, Questions and Answers about Drainage Water Management for the Midwest”* (WQ-44, Purdue Extension) and *“Ten Ways to Reduce Nitrogen Loads from Drained Cropland in the Midwest”* (Pub C1400, University of Illinois Extension). Furthermore, we received ASABE Educational Aids Blue Ribbon – Short Publication (<9 pages) in 2018 for an extension bulletin entitled Agricultural Drainage (E3370, Michigan State University).

### **4. Added-Value and Synergistic Advantages from Interdependencies**

The team consists of 22 core members (agricultural engineering, agronomy, crop, plant and soil sciences) from 13 institutions (LGU and non-LGU), USDA-ARS and USDA-NRCS, and other collaborators (state and federal government agencies, industry, NGOs). Our annual meeting includes presentations from all these groups to provide a comprehensive update spanning research, outreach, policy, and industry issues. Moreover, we include a graduate student poster session to encourage younger scientists and continue our momentum into the future. NCERA217 works closely with SERA46 “Framework for Nutrient Reduction Strategy Collaboration: The Role for Land Grant Universities” on drainage issues within the Mississippi watershed. We are strongly integrated with the drainage industry; for example, industry members formed the Agricultural Drainage Management Coalition ([ADMC](#)) to work with us in developing and promoting new technologies for reducing tile drainage nutrient losses. Our multi-million-dollar external funding successes include the formation of the [Transforming Drainage](#) group and website which provides information for industry, researchers, state and federal agencies, and farmers on improved drainage practices currently under evaluation. In the last two years, this website attracted nearly 7,500 users

(>24,000 page views) from the United States, India, United Kingdom, Canada, China, Philippines, Germany, Nigeria, and Iran. More than 70 individuals from 15 states and three countries have signed up to receive regular Transforming Drainage project updates.

## **5. Grants Received**

Evidence of Multi-Institutional and Leveraged Funding: Collaborative efforts among committee members resulted in multi-institutional and cross-disciplinary projects totaling more than \$27M (see below). Additionally, these relationships were instrumental in acquiring more than \$8M of in-state grants not listed. These projects often include industry participation.

Drainage Water Management for Midwestern Row Crop Agriculture: \$970K funded by USDA-NRCS-CIG

Climate Change, Mitigation, and Adaptation in Corn-Based Cropping Systems: \$20M funded by USDA-NIFA-AFRI-CAP

Coordinated Site Network for Studying the Impacts of 4R Nutrient Management on Crop Production and Nutrient Loss: \$2M funded by the Foundation for Agronomic Research and The Foundation for Food and Agriculture Research

Managing Water for Increased Resiliency of Drained Agricultural Landscapes: \$4.5M funded by USDA-NIFA-AFRI

## **Participating Institutions and Units:**

### **Official NIMSS Participants**

Cornell University, Iowa State University, Michigan State University, North Carolina State University, North Dakota State University, Purdue University, South Dakota State University, University of Georgia, University of Illinois, University of Kentucky, University of Minnesota, University of Missouri, USDA-ARS – IA, USDA-NRCS – West National Technology Support Center, and Virginia Polytechnic Institute and State University

### **University Collaborators**

University of North Dakota  
University of South Dakota  
University of Iowa  
University of Manitoba

### **Government Collaborators**

Ag and Agri Food Canada - MB, ON  
USEPA, Region 5  
Minnehaha Co., SD  
Minnesota Department of Agriculture  
North Dakota Water Commission  
USDA-NRCS – AR, DC, IN, MI, ND, OH, SD, TX  
South Dakota Department of Agriculture  
USDA-ARS – IN, OH  
USGS – Ohio Valley

### **Industry Collaborators**

Agricultural Drainage Management Coalition  
AgriDrain Corp., IA  
Ecosystem Services Exchange (ESE), FL  
Prinsco, MN  
Springfield Plastic, IL  
Trimble, OH

### **NGO Collaborators**

Farm Bureau, SD  
Illinois Soybean Association  
Iowa Soybean Association  
Iowa Drainage District Association  
The Nature Conservancy