SOIL AND WATER CONSERVATION SOCIETY

Healthy Land, Clean Water:

CULTIVATING A LEGACY OF CONSERVATION

78th SWCS INTERNATIONAL ANNUAL CONFERENCE

DES MOINES, IOWA | AUGUST 6-9, 2023

ABSTRACT BOOK

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**Denotes primary author*

SYMPOSIA

PRESENTATIONS

MONDAY, AUGUST 7

SYMPOSIA SESSION DESCRIPTIONS AND AGENDA

Conservation Innovation Grants (CIG) Showcase
10:30 AM – 5:00 PM, *Room 303 on Main Level*
The USDA Natural Resources Conservation Service (NRCS), in conjunction with SWCS, will host the CIG Showcase at the SWCS Annual Conference. Since 2004, CIG has supported the development of innovative natural resource conservation approaches and technologies on working lands.

This year's showcase includes an overview of the CIG program and three themed panels. The first panel is an introduction and highlights the variability of the CIG program, the second panel explores water quality and nutrient management, and the last panel covers soil health and cover crops.

This showcase runs from 10:30 AM to 5:00 PM on Monday, August 7. Following the showcase, CIG project posters will be included in the poster presentation session held in the poster display area of the exhibit hall from 5:00 PM to 7:00 PM.

Introduction
10:30 AM – 12:00 PM

Introduction: Conservation Innovation Grants Program Overview and Stakeholder Updates – *Caroline Sherony and Havala Schumacher, USDA-NRCS*

Presentation 1: Bee-Friendly Beef: Integrating Native Wildflowers into Southeastern Grazing Systems – *Ben Tracy, Virginia Tech*

Authors: Ben Tracy*, David Bellangue, Elizabeth Chishimba, Amy Johnson, Pat Keyser, Parry Kietzman, Jonathan Kubesch, Catherine Larochelle, Megan O'Rourke, Gabe Pent, Jessica Prigge, J. Leighton Reid, Erin Shibley

Pollinators have experienced precipitous declines in recent decades due, in part, to changing land use and declines in floral resources. Integrating native wildflowers into pastures across the 37 million acres of the fescue belt in the Southeastern U.S. has the potential to conserve pollinators while maintaining cattle production. Virginia Tech has partnered with the University of Tennessee and Virginia Working Landscapes to develop bee-friendly beef production technologies through field experiments and on-farm demonstrations. Our work addresses these main objectives: 1) to demonstrate the establishment and persistence of wildflowers in grazing systems; 2) to assess the benefits of wildflower-enhanced grazing systems for cattle and pollinators; and 3) to evaluate the economic potential of wildflower-enhanced grazing systems. Strategies for native wildflower establishment were evaluated in several field experiments that tested different site preparation treatments, planting timings, seeding rates, and seed treatments. Results were mixed, but site preparations using Roundup herbicide and tillage provided the best establishment success of wildflowers. High seeding rates (e.g., > 10 lbs./ac.) and cold seed treatments also improved establishment. Grazing trials in wildflower-enhanced pastures have shown no negative effects on beef cattle performance. Preliminary data from on-farm demonstration plantings using native wildflowers in northern Virginia suggest these plantings attracted more native pollinators than adjacent tall fescue pasturelands. Economic analyses of wildflower-enhanced grazing systems are still in process, but results from a survey suggest consumers would pay more for beef labeled 'Bee-friendly'. Overall, our results suggest wildflower-enhanced pasturelands should generate greater ecosystem services without

negatively impacting cattle, but better ways of achieving weed control and greater wildflower establishment consistency are still needed.

Presentation 2: Landowner Collaborative Strategies for Nonlethal Predator Control – *Gary Burnett, Heart of the Rockies*

Authors: Jared Beaver, Stewart Breck, Gary Burnett*, Matt Collins, Erin Edge, Emily Harkness, Matthew Hyde, Kyran Kunkel, Rachel Nickerson, Bre Owens, Jay Shepherd, Julie Young

The Landowner Collaborative Strategies for Nonlethal Predator Control Classic Conservation Innovation Grant has adopted the working title of Conflict on Working Lands Conservation Innovation Grant (CoW-CIG), where the team is working to innovate and evaluate non-lethal tools in the context of comprehensive wildlife conflict reduction. Initiated in 2021, the goal of the project is to reduce the financial and social burden on producers of expanding predator populations on working lands. The CoW-CIG team is researching costs, efficiency, and effectiveness within varying ecological contexts. This work has assisted in the development of new scenarios and cost lists for the adoption of three practices - range riding, carcass management, and various fencing scenarios – to be incentivized through Natural Resources Conservation Service Farm Bill programs. These practices offer win-win solutions for predation risk management on shared landscapes to support both livestock production and wildlife, including large predators. We are developing a planning framework and guiding principles document that can be used to determine if and where the strategic application of these practices can address localized predation risk in areas that are primarily occupied by humans, wildlife, or both. For example, a permanent multi-strand electric fence is suitable for primarily human-occupied space. Carcass management is suitable for both human and shared spaces, and range riding is suitable for shared space and, at times, predator space, such as near a den location or rendezvous site. This localized approach of spatial and/or temporal separation avoids ecological traps that increase wildlife mortality, leading to more permeable habitats that allow for wildlife movements within and across connected landscapes. Implementation of these practices supports an adaptive management system to maintain or improve a functional landscape by promoting the integration of resource concerns, including terrestrial wildlife habitat, riparian or rangeland plant structure and composition, streambank erosion, and livestock productivity from a feed and forage imbalance.

Presentation 3: Equity-Based Regenerative Agriculture through Carbon Capture and Utilization Technology: The Community Carboneers Collaborative; A Community-Based Approach to Regenerative Agriculture Technology Development and Dissemination – *Brett Kencairn and Ellena Ignacio, Rid-All Foundation*

Authors: Brett KenCarin, Marc White, Ellena Ignacio*

Urban agriculture is increasingly recognized as an important strategy to increase food security and food quality, and nutrient density in underserved urban areas. Similar needs exist in many rural areas, particularly native communities. In order to increase the share of each year in which these foods can be made available, strategies for season extension are necessary. In this initiative, community-based agricultural efforts serving lower-income or underserved communities are working together to develop season-extending bioenergy systems that produce coproduct biochar. This biochar material is then integrated into compost and other soil-enhancing strategies to further improve productivity, resource efficiency, and organic materials management as a strategy to improve the long-term viability of these community-based agricultural operations.

Water Quality and Nutrient Management
1:30 PM – 3:00 PM

Presentation 1: Synergistically Combining Autonomous Irrigation and Cover Crops for Sustainability – *Dave Spencer, Jason Krutz, and Keri Lewis, Mississippi State University*

Authors: Dave Spencer*, L. Jason Krutz, Drew M. Gholson, Erick J. Larson

Expanding the adoption of conservation practices can reduce agricultural non-point source pollution and aquifer decline in the Lower Mississippi River Basin (LMRB). This research is being conducted to facilitate the adoption of scientifically validated conservation practices in the LMRB by demonstrating and evaluating at the field scale how row-crop production systems can be designed to enhance water resources and productivity. A survey was deployed to identify the socioeconomic and cultural factors that influence the implementation of conservation practices in the LMRB. Concurrently, demonstration and evaluation sites were established across the Delta region of Mississippi to determine the effects of employing high residue production systems, irrigation water management tools, and autonomous technologies on runoff water quality, irrigation water use efficiency, yield, and profitability. Analysis of survey and field data is currently underway. Preliminary analysis of survey results reveals that farmers generally perceive high residue production systems as environmentally beneficial but potentially less advantageous to cash crop yield and profitability. Additionally, this research suggests that farmers prefer information transfer to be personal and direct. An initial analysis of environmental and agronomic data from demonstration and evaluation sites is currently underway. Runoff water quality and crop productivity data will be presented.

Presentation 2: Improving the Economic and Ecological Sustainability of US Crop Production through On-Farm Precision Experimentation: Progress and Status of the Data-Intensive Farm Management Project – *David S. Bullock, University of Illinois*

Authors: David S. Bullock*

The goal of the Data-Intensive Farm Management (DIFM) project is to allow NRCS to provide incentives to farmers that will increase, on a grand scale, the input use efficiency, profitability, and sustainability of US crop production. DIFM's multi-disciplinary team is working with a large, diverse set of farmers, crop consultants, and researchers to create principally automated "cyber-infrastructure" for on-farm precision experimentation (OFPE), the analysis of the data generated, and the practical application of that analysis to enable farmers to make data-informed input management decisions that improve both the economic and ecological sustainability of crop production. OFPEs rely on computerized field trial design and precision agriculture technology to enable farmers to implement large-scale, randomized input rate experiments, at minimal cost and bother. The project also aims to revolutionize the extension services systems of US land grant universities, making their goal to work efficiently with private crop consultants and agriculture input dealers, who have the human and material resources to reach farmers face-to-face throughout the nation. DIFM has run nearly 300 OFPEs, from about 40 to over 250 acres in size, in eighteen states, Brazil, Canada, Argentina, Uruguay, and South Africa. DIFM has finished the development of the trial design component of its cyber-infrastructure and is scheduled to have a complete, early version ready for the International Conference for On-Farm Experimentation, which will be held in January 2024.

Presentation 3: On-Farm Demonstration and Evaluation of an Innovative Calibration Strip-Based Precision Nitrogen Management Technology for Corn - *Yuxin Miao, University of Minnesota*

Authors: Yuxin Miao*, Katsutoshi Mizuta, Ana Morales Ona, Daniel J. Quinn, Renzo Negrini, Solomon Folle, Junun Lu, Jeffrey Coulter, David Mulla, Kevin Kuhner, Robert Nielsen

Improper management of nitrogen (N) fertilizers in the cropping systems of the U.S. Midwest has resulted in surface and groundwater pollution, and significant N flux into the Mississippi River Basin that flows to the Gulf of Mexico. The University of Minnesota has developed an innovative remote sensing and calibration strip-based precision N management system to support farmers making in-season site-specific N management decisions using year-, site- and hybrid-specific calibration information and high spatial and temporal resolution satellite remote sensing images. This system can be implemented in farmers' fields directly without the need for previous data collection, and farmers don't need to purchase any new equipment if they have access to variable

rate applicators. As opposed to adopting only one approach, this system combines different N management options and is more robust and adaptive and lowers the danger of high yield and financial losses brought on by unfavorable weather conditions. The objective of this project is to demonstrate and evaluate the remote sensing and calibration strip-based precision N management system to quantify the agronomic, economic, and environmental benefits under diverse on-farm conditions and promote wider adoption by corn growers. To evaluate this system in comparison with farmers' practices and a commercially available crop development model-based N management approach (2021–2022), 49 on-farm trials were carried out in Minnesota and Indiana in 2021–2023. The preliminary results indicated that the precision N management system could achieve a similar yield with fewer N fertilizers, significantly increased N use efficiency, and reduced N losses. The economic benefit of this system was influenced by weather conditions and grain and N fertilizer prices.

Presentation 4: Innovating through Barriers for Bioreactors and Saturated Buffers – *Laura Christianson, University of Illinois*

Authors: Laura Christianson*, Lori Abendroth, Reid Christianson, Richard Cooke, Carolina Díaz-García, Gary Feyereisen, Lindsey Hartfield, Christopher Hay, Matthew Helmers, Thomas Isenhart, Gabriel Johnson, Jeppe Kjaersgaard. Lindsay Pease, Michelle Soupir

Edge-of-field practices, such as denitrifying woodchip bioreactors and saturated riparian buffers, are increasingly recognized as crucial but underutilized practices within our conservation portfolio. These two are relatively new water quality practices, but both have been studied sufficiently to allow the development of NRCS Conservation Practice Standards (CPS 605 and 604). The overarching goals of this project are to apply innovative design and monitoring techniques to clean more nitrogen from tile drainage leading to an accelerated bioreactor and saturated buffer adoption. As an early part of this project, novel bioreactors, and saturated buffers were designed and built in the three-state project area. For example, new pumped bioreactors have demonstrated expanded practice applicability, and dual-line saturated buffers are being assessed for increased water treatment capacity. A complementary project objective explores new edge-of-field monitoring techniques (nitrate sensors; nitrate disks). Hi-frequency, web-connected nitrate sensors deployed at two bioreactors have aided real-time bioreactor management and may be a pathway for real-time nitrate trading in future water quality markets. Nitrate disks using diffusive gradients in thin films (DGT) technology have delivered promising time-composite nitrate concentrations in field deployments across the project region. As water quality continues to play a prominent role in environmental outcomes, accelerating the adoption of edge-of-field practices will become increasingly important. Our project's aim is increased adoption of bioreactors and saturated buffers and corresponding improved water quality.

Presentation 5: Promoting the Adoption of Innovative Precision Ag Nitrogen Management Technologies through the Nebraska On-Farm Research Network for Improved Conservation Stewardship: Evaluation of Precision Ag Nitrogen Management Technologies through the Nebraska On-Farm Research Network in Corn and Winter Wheat - *Jose Guilherme Cesario Pereira Pinto, Laila Puntel, and Laura Thompson, University of Nebraska*

Authors: Jose Guilherme Cesario Pereira Pinto*, Nathan Mueller, Taro Mieno, Laura Thompson, Laila A. Puntel

The objective of the precision nitrogen (N) management project (PNP) is to help producers evaluate the impact of precision N technologies that can increase nitrogen use efficiency (NUE) in corn and winter wheat. Producers work closely with the project team to select a technology that fits their operational logistics, gain hands-on experience and technical support in implementing the technology selected, and evaluate the impact of the technology on productivity, profitability, and efficiency. Overall, a total of 120 on-farm experiments are being conducted with growers over three years to evaluate and promote the adoption of remote sensing, crop modeling, enhanced efficiency fertilizers, and biological technologies, which are expected to increase NUE. Here we present a subset of project results, focusing on seven winter wheat on-farm experiments which evaluated satellite and drone remote sensing tools to produce variable-rate N recommendations. We compared the yield,

NUE, and partial profit from the N recommendation tools to the growers' standard management. The economic optimum N rate (EONR) was estimated by placing nitrogen rate ramps in the field, allowing the remote sensing technology and growers' management to be benchmarked spatially within the field. The performance of the remote sensing N management varied between fields, and the researchers plan to investigate what factors influenced the performance at a site-specific level. Importantly, the impact of the PNP on the adoption of precision N technologies documented through conversations with participating growers will be discussed.

Presentation 6: Using a Regional Ag Data Network to Accelerate Water Reuse and Water Quality Considerations in Irrigation Systems – *Dennis Carman, WhiteRiver Regional Irrigation*

Authors: Dennis Carman*

Excessive withdrawal of groundwater has resulted in a critical decline in aquifer levels across the Grand Prairie region of Arkansas. Tail-water capture, on-farm irrigation storage reservoirs, and water re-use practices are being widely adopted within the region, but data to refine, measure, monitor, and manage these conservation practice changes is limited. Our project implements a low-cost Ag Data Network to fill that data void. Our network measures and transmits real-time data for weather, soil moisture, tail water capture, water reuse, and water quality on a real-time basis. On-farm soil moisture sensor data is reported and available for direct integration with the University of Arkansas Irrigation Scheduling App. We have established a functioning data reporting system serving about 1 million acres that is affordable, reliable, and robust, with a relatively small initial investment and small supporting data fees. This network measures, records, and transmits our most needed AG data parameters using commercially available sensors. The network is easily expanded and can be installed nearly anywhere.

Soil Health and Cover Crops
3:30 PM – 5:00 PM

Presentation 1: Real-Time Farmer Learning on Benefits of Cover Crops for Managing Soil Health, Economics, and Water and Nutrient Dynamics - *Chris Reberg-Horton, North Carolina State University*

Authors: Chris Reberg-Horton*

This project was conceived to expand the Precision Sustainable Agriculture Network in part of the central U.S. and with an industry partner involved in carbon markets. The PSA network of researchers, farmers, ag professionals, industry, and NGOs comprise a national alliance that integrates technology, and real-time data flow (aggregation, analytics, and visualization), in the Cloud, to demonstrate and co-learn/build with farmers to promote the use of soil health management principles, particularly with regard to carbon storage, nitrogen cycling, and water infiltration and storage. The network's goal is to distill our large datasets into Decision Support Tools for farmers that will guide the management and utilization of cover crops for environmental and economic outcomes.

Presentation 2: Carolina Cotton Can Conserve Soil with Cover Crops - *Bhupinder Singh Farmaha, Clemson University; Alan Franzluebbers, USDA-ARS*

Authors: Bhupinder Singh Farmaha*, Alan Franzluebbers, Shikha Dubey

Conservation management practices, including cover cropping, animal manure utilization, and reduced tillage, have the potential to restore and enhance soil health. However, soil type and management history can significantly affect soil health and associated benefits from conservation practices. In this project, we are collaborating directly with progressive and curious cotton farmers in the Coastal Plain of South and North Carolina. Our objectives are twofold: (1) to encourage the adoption of field-validated and proven soil-health management systems involving cover crops and conservation tillage, and (2) to assess the impact of these management systems on soil health and crop productivity. Through on-farm demonstrations, we are

highlighting the advantages of utilizing multi-species cover crops compared to single-species cover crops at some sites, while at other sites, we are showcasing the benefits of cover cropping and strip-tillage in comparison to no cover cropping and no-tillage practices, respectively. Soil samples are being collected from two depth profiles of particular influence: (1) the surface layer (0-10 cm) to assess changes in various soil health indicators, and (2) the 0-60-cm profile (0-10, 10-30, and 30-60 cm) for detecting residual inorganic nitrogen and profile distribution of other soil fertility characteristics. Farmers in the region currently do not incorporate soil testing to account for residual inorganic soil nitrogen or properly crediting nitrogen from previous legumes or cover crops when making soil nitrogen fertilizer applications. Specific results will be shared in the presentation. This on-farm demonstration project has significance for promoting soil-health management systems and establishing a comprehensive soil health database. These efforts will enable the refinement of soil fertility recommendations and enhance farm profitability in the southeastern United States.

Presentation 3: Cover Crop Trials through Indiana's INField Advantage Program - *Trevor Laureys and Joe Rorick, Indiana Soybean Alliance*

Authors: Trevor Laureys*, Joe Rorick*

The INfield Advantage program is a collaborative program made possible through a partnership between the Indiana Soybean Alliance, Indiana Corn Marketing Council, Indiana Department of Agriculture (ISDA), and Truterra, LLC, the sustainability business of Land O'Lakes, Inc. This program offers Indiana farmers resources and tools to try different management techniques, including reduced tillage, nutrient management, or cover crops on their farms, and evaluate the results before deciding to adopt the practice. By mitigating the risk of trying new management decisions and providing environmental and economic benchmarking, the program aims to help farm managers, operators, and landowners alike make more informed conservation decisions. This presentation will cover the cover crop trial program structure, logistics, and execution of a small-scale, but statewide effort. The speakers will examine anonymized soil sampling, biomass sampling, and farm management data from the length of the program with a focus on key takeaways and how this informs future programming for reaching growers outside of traditional government cost-share programming.

Presentation 4: Innovative Strategies for Cover Crop Termination: Demonstrating the Full Agronomic and Economic Value of Cover Crops to Accelerate Soil Health Management System Adoption - *Laura Tessieri and Christian Bench, North Jersey RC&D*

Authors: Laura Tessieri*, Christian Bench*

This project is a soil health demonstration that compares typical northeastern US cover crop termination practice (termination in early to mid-spring, using herbicide, weeks before planting) against innovative methods of delaying cover crop termination and cash crop planting. These innovative methods include planting into (1) a green living cover crop, (2) a mature cover crop terminated using a roller-crimper, and (3) a cover crop intensively grazed by livestock. These strategies maximized soil cover, biodiversity, and the presence of living roots in annual crop systems, ultimately increasing the agronomic and economic value of cover crops to agricultural producers.

Using a paired study design, three treatments (aforementioned cover crop termination methods) were compared against control plots (existing termination practices) on 25 farms (1500 acres total of northern New Jersey cropland). Using a combination of soil samples and field assessments, farm data, and farmer interviews, NJRCD and partners evaluated and documented cover crop termination approaches to help farmers realize the full benefits of cover crops.

Through this project, a NRCS scenario for Planting Green was developed. In addition, a YouTube series was created, factsheets on the practices, a bulletin of the in-field soil impacts of the trial, and case studies documenting the economic and social impacts of treatments.

Presentation 4: Covering Ground: Investigation of Cover Crops for Soil Health in the Great Lakes Region - *Dennis Busch, Andrew Cartmill, and Will Keast, Water Resources Monitoring Group*

Authors: Greg Thoren*, Nathan Koester*, Dennis Busch, Andrew Cartmill

Our On-Farm Conservation Innovation Grant project focuses on the investigation of a variety of innovative conservation approaches directly related to soil health, water quality, and the use of cover crops, through robust on-farm demonstrations at the plot, replicated strip, field, and paired-basin scale. The conservation approaches have been designed through iterative discussions with farmer-led watershed groups to match issues and challenges particular to their geographic region and production systems. Data presented within the NRCS Conservation Innovation Showcase will focus on activities and lessons learned by participating farmers that are members of the Jo Daviess County Soil and Water Health Coalition, which is in the driftless region of northwestern Illinois. Specific topics of discussion will include water quality and soil health measurements related to reduced tillage, cover crops, inter-seeded cover crops, and livestock grazing practices.

Professional Development Sessions
10:30 AM – 5:00 PM, *Room 304 on Main Level*
The professional development sessions are for the growth of professionals. These sessions will help professionals become more effective across the diverse set of fields that serve conservation. You will learn from the experiences, challenges, and successes of other conservation professionals.

Expand your Influence: Understanding Generational Perspectives
10:30 AM – 12:00 PM

Moderators: *Brandi Murphy and Jessica Rock, WiN*

Panelists: *John Hubbert, Acting Regional Conservationist, Northeast, NRCS. Representing The Baby Boomer Generation; Julie MacSwain, Volunteer for National Headquarters, NRCS. Representing the Baby Boomer Generation; Dean Krehbiel, State Resource Conservationist, NRCS Kansas, Representing Generation X; Rachel Frei, Urban Conservationist, NRCS South Dakota, Representing the Millennial Generation; Joe Buford, State Resource Conservationist, NRCS Vermont. Representing the Millennial Generation; Haleigh Summers, Ph.D. Candidate Sustainable Agriculture & Environmental Science- Iowa State University. Representing the cusp of Generation Z and Millennials*

Panelists representing different generational perspectives will take part in a round-robin style Q&A panel.

Creating a Compelling Culture
1:30 PM – 2:10 PM

Presenter: *Jason "JC" Gayle, Compel Movement, LLC*

Whether your home, school, workplace or even relationships, how we feel about those spaces rests on the culture that exists within that environment. Creating a Compelling Culture is not only vital to the health of those spaces but it's also the biggest difference maker between those that thrive and others that are struggling to survive. Are you in a Compelling, Inspiring, and desirable environment? If not, here's how you can.

Finding Success through Conflict Resolution
2:15 PM – 3:00 PM

Presenter: *Scott Tillema, The Negotiations Collective*

Engaging in conversations with aggressive, emotional people can one of the most stressful and challenging task professionals face today. Finding Success through Conflict Resolution will allow attendees to learn professional level conflict resolution and negotiation techniques with an FBI-trained hostage negotiator.

In this session, the attendees will be presented with a flexible framework they can use to effectively work through even the most frustrating interactions. Regardless of whether we are executives or front-line representatives, we must excel at conflict resolution in order to give ourselves the best chance of success in these critical moments.

This session will empower you to engage in conflict respectfully and strategically instead of backing away! Tools and strategies will be discussed on how to get to the root cause of objections, implement acceptable solutions, while engaging in active listening and de-escalation.

Attendees will leave this session more confident and prepared to handle difficult conversations and situations, allowing them to find success for their teams and their clients.

Mission-Driven Success in Grant Writing and Fundraiser for Conservation Programs!
3:30 PM – 4:10 PM

Presenter: *Ann Wolf, MidwesthealthyAg.ORG*

What drives you and your organization's passion to support conservation? What do you and your organization care about in your fundraising efforts to achieve mission and goal objectives in conservation? Where do you and your organization's passion lie in conservation engagement and preservation? These basic questions are at the heart of successful grant writing and fundraising for conservation nonprofits, organizations and even businesses.

Fundraising and grant writing need to reflect you and your organization's deeply held mission, vision, values and goals. At the heart of your organization's existence is the need to meet a problem that currently exists, or will exist in the future without corrective intervention and action- which your organization can offer in several program and project areas. Presenting the urgency, importance and giving opportunity for stakeholders and funders to engage in conservation's successes will result in positive outcomes. Grant writing and fundraising in conservation need to capture critical reasons for stakeholder commitment and support enabling funders to be a part of the cause by meeting their concerns and needs in conservation efforts. Learn more practical techniques in this session for conservation professionals in grant writing and fundraising for mission-driven success.

Perfecting your Pitch: Strategies to Tell your Soil and Water Story
4:15 PM – 5:00 PM

Presenter: *Rebekah Jones, Iowa Agriculture Water Alliance*

In this session, I walk attendees through the process of creating and following through with a strong media pitch to tell the story of their project or organization. From relationship building and media market research, to forming a written and verbal pitch, to preparing for the actual interview, successful "earned media" is more than just dialing up the newsroom number! Learn the behind-the-scenes newsroom secrets from a former reporter and anchor!

Biochar: Conservation Innovation for Climate-Smart Agriculture and Forestry
Room 305 on Main Level

Track: Climate-Smart Agriculture

Time: 10:30 AM – 12:00 PM CT

Moderator: *Loretta Metz, USDA-NRCS*

Presenters: *Loretta Metz (NRCS); Kristin Trippe (ARS); Rachel Seman-Varner (American Farmland Trust); Michael Margo (USDA-NRCS); Richard Reid (NRCS)*

Land application of biochar has been identified as a "Frontier Technology" in climate change mitigation and adaptation (Paustian et al. 2019) with a mitigation potential of 1.8 Pg CO2e per year (Woolf et al. 2010). The research on biochar to enhance agricultural and environmental sustainability is extensive and spans decades, with the number of publications and patents increasing exponentially in the last ten years (Gelardi and Parikh 2021). The physical and chemical properties of biochars are highly variable and based on feedstocks and production methods. The effects of biochar application on land are also highly dependent on soil and site properties, land use, and management. This symposium will explore the nexus between cutting-edge research and innovative policy related to biochar. We will feature two tools to evaluate biochar products and plan for land application and the technical and financial assistance to manage biochar for conservation benefits. Michael Margo will moderate the session. Rachel Seman-Varner will present an overview of the current state of biochar research, research gaps, and future research priorities. Kristin Trippe will present the evolution of the foundational decision support tool, The PNW Biochar Atlas, and the next steps in nationalizing the tool. Richard Reid will present on the development and use of the dynamic soil property response to biochar SSURGO interpretative tool within Web Soil Survey. Loretta Metz will present the current status of the new Conservation Practice Standard Soil Carbon Amendment (Code 336). The session will conclude with a Question-and-Answer panel discussion.

All Acres for Our Water: Systems Change for a 20% Reduction
Room 306 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 10:30 AM – 12:00 PM CT

Moderator: *Peter E. Mead, The Nature Conservancy*

Presenters: *Peter Mead (The Nature Conservancy); Andrea Eger (The Nature Conservancy); Dennis Fuchs (Stearns County Soil & Water Conservation District); Amy Robak-Bruce (Centra Sota Co-op); Nathan Hylla (Kanati Land Management); Ben Mergen (Mergen Farms)*

From the top to the bottom of the Mississippi River Basin, scientists and the public have long been raising the alarm, calling for a 20% reduction of Nitrogen and Phosphorus delivery to the River and the Gulf of Mexico. The conservation community says it can happen, so what exactly is it going to take? Sparked by an infusion of private funding, The All Acres for Our Water project leverages an ideal mix of local, state, federal, and private interests to put that very question to the test. Join us as we dissect the social, economic, agronomic, and technical aspects of a concentrated effort to achieve targeted soil loss and nutrient reductions in a HUC12 watershed in the upper reaches of the Mississippi River Basin in North Central Minnesota.

Intended to be scalable from the beginning, the All Acres for Our Water Project employs three primary strategies: Appealing to landowners' beliefs and norms, emphasizing the community benefits of conservation, and addressing individual and community-level constraints to conservation behavior. With these strategies in mind, we've pushed ourselves to think outside of the box to increase the implementation of Best Management Practices across a diverse mix of row crop, livestock, and dairy operations.

We'll offer perspectives from conservation district staff, crop consultants, local growers, and non-government organizations as we discuss the ins and outs of building a coalition of farmers, agricultural retailers, farm advisors, government entities, and non-profits to move the needle and achieve measurable reductions.

Measuring Nonpoint Source Nutrient Reductions in the Mississippi River Basin through the Gulf Hypoxia Program
Room 305 on Main Level

Track: Adaptive Management of Conservation Efforts

Time: 1:30 PM – 3:00 PM CT

Moderator: *Whitney M. King, US EPA*

Presenters: *Katie Flahive (U.S. Environmental Protection Agency); Trevor Sample (Illinois Environmental Protection Agency); Trevor Laureys (Indiana State Department of Agriculture)*

The Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) is a collaboration of 5 federal, 12 state agricultural and environmental agencies, and the National Tribal Water Council. The HTF develops and implements workable solutions to reduce nutrient input into the Mississippi and Atchafalaya River Basin (MARB) and the hypoxic zone in the northern Gulf of Mexico. The HTF has a challenging goal of 20% nutrient reduction by 2025 and 45% nutrient reduction by 2035 to reduce the size of the hypoxic zone to less than 5000 km^2. States implement unique Nutrient Reduction Strategies while federal agencies provide support through financial, technical, and other measures. Recently, the HTF received significant financial assistance to advance the implementation of nutrient reduction strategies and the goals of the HTF.

In November 2021, President Biden signed the Bipartisan Infrastructure Law (BIL), which includes approximately $50 billion to the U.S. Environmental Protection Agency (EPA), the single largest investment in clean water that the federal government has ever made. The BIL established the Gulf Hypoxia Program (GHP), which manages and distributes $12 million per year for five years ($60 million in total) for actions to support the HTF Gulf Hypoxia Action Plan. The BIL GHP will enable the states and tribes to provide tangible benefits to communities and ecosystems across the region that depend on clean water. Through improved water quality, communities across the MARB can benefit from safer drinking water, protected fisheries, and a more stable economy.

This symposium will explore the actions HTF members are taking with GHP funds to advance the goals of the HTF and implement their nutrient reduction strategies. It will cover the breadth of projects across the basin and demonstrate the variety of actions HTF partners are taking to advance stakeholder engagement, expand capacity, and improve water quality within states and throughout the region.

The Role of Climate-Smart Agriculture in Soil and Water Conservation and Air Quality
Room 306 on Main Level

Track: Climate-Smart Agriculture

Time: 1:30 PM – 3:00 PM CT

Moderator: *Gretchen Sassenrath, Kansas State University*

Presenters: *Dennis Todey, USDA ARS; Andy Manale – Retired ERS; Deanna Osmond, North Carolina State University; Dana Ashford-Kornburger, USDA NRCS (Presented by the Science and Policy Committee of SWCS)*

Climate-smart agriculture has come to the forefront as an approach to simultaneously increase agricultural productivity, while enhancing resilience to climate impacts and mitigating greenhouse gas emissions from agriculture. This concept integrates well-known conservation strategies such as cover cropping, agroforestry, nutrient management, and conservation tillage. Climate-smart agriculture has gained attention recently through legislation and increased funding directed at tackling this complex issue. Yet conservationists and researchers may be asking – what do I need to do to make my program "climate-smart"? Implementing a Climate-smart initiative requires addressing the agroecosystem in a holistic way to incorporate technology and delineate solutions to productivity, profitability, and environment – all while remaining within the lens of climate resilience and adaptation. In this workshop, presented by the Science and Policy Committee, we will explore the multidimensional aspects of climate-smart agriculture. Experts in diverse fields will share their ideas on where climate-smart agriculture is going and how conservationists and researchers can integrate this perspective into their current work.

Edge-of-Field Blitz: Guiding the Process
Room 307 on Main Level

Track: Edge-of-Field Practices and Monitoring

Time: 1:30 PM – 3:00 PM CT

Moderator: *Caleb D. Rasmussen, ISG; John Swanson, Polk County Public Works*

Presenters: *Caleb D. Rasmussen (ISG); John Swanson (Polk County Public Works)*

A reflection on the process to implement an edge of field blitz. Including outreach, survey + investigation, planning, design, bidding and construction and lessons learned.

Climate-Smart Practices: The Role of Certified Crop Advisors in Decision-Making
Room 305 on Main Level

Track: Climate-Smart Agriculture

Time: 1:30 PM – 3:00 PM CT

Moderator: *Dennis Todey, USDA-ARS*

Presenters: *Linda Prokopy (Purdue University); Betsy Bower (CERES Solutions); Tyler Williams (Bayer Crop Science); Hans Schmitz (Purdue University)*

Agriculture has the ability to adapt to changing climate conditions and does this regularly through adopting soil and water management, seed, and even in cases cropping system shifts. Increasingly, climate change is making adaptation more difficult or impossible in cases requiring more concerted discussion about changing agronomic and climate conditions. The recent increase in management options associated with the burgeoning “climate-smart agriculture” programs (public and private) add another economic component to the agronomic decisions. To support these wide-ranging decisions, many producers consult certified crop advisers (CCAs) to discuss management options. These CCAs work for COOPs, seed companies or are independent consultants. Thus, CCAs have a very influential role in suggesting options for producers to adopt new “climate-smart” strategies. The CCA's role as an influential voice to producers is well-known and published. But this role has not been discussed extensively as a communicator of climate-smart practices or the science associated with them. Also, the role of understanding practices and their climate, as well as agronomic implications, is not clear. This symposium will bring CCAs, advisers, USDA, other sustainability professionals, and social scientists together to discuss the CCA's role and ability to incorporate CCAs into climate-smart agriculture advising. It will also discuss the linkage between developing research in agronomic management practices and sharing with in-field decision-makers. Note that climate-smart agriculture here is not defined but left open to a wide range of practices for the purpose of the panel.

Building a Conservation Agronomist Program
Room 306 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 3:30 PM – 5:00 PM CT

Moderator: *Jeffrey Kappen, Baton Global*

Presenters: *Roger Wolf (Iowa Soybean Association & Agriculture's Clean Water Alliance; Thomas Fawcett (Heartland Co-Op); Jeffrey Kappen (Bâton Global & Drake University)*

How can business and conservation professionals collaborate to accelerate the adoption of conservation practices? How do their knowledge and services combine to create a more robust value proposition for supporting farmers? This Symposium will profile different approaches to embedding and leveraging conservation agronomists with and within commercial agricultural retailers towards answering these questions. Based on a conservation agronomist program (CAP) pilot project across Iowa over the past two years, the speakers will address challenges, innovations, and emerging leading practices in promoting conservation practices across diverse farmer communities.

The Symposium will begin with an overview of the initial intention of creating the CAP and the needs it has sought to address. CAP members will then share views and experiences from both the business and agronomist perspectives. From the retailer perspective, how has the CAP enhanced the services and engagement with farmers? From the agronomy perspective, how has cooperation increased conservation adoption and grower engagement? The symposium will also include the results of an evaluative study examining the conservation and economic impacts of the CAP across the state. The session will conclude with future considerations for balancing the public and private costs and benefits toward creating sustainable business models moving forward. As such, symposium attendees will leave with not only concrete ideas for how to set up and scale a CAP, but also an understanding of how to make the case to retailers, farmers, and funders who could consider participating in its activities.

TUESDAY, AUGUST 8

SYMPOSIA SESSION DESCRIPTIONS AND AGENDA

CEAP Showcase
10:30 AM – 5:00 PM, *Room 303 on Main Level*
The Conservation Effects Assessment Project–Watershed Assessment Studies (CEAP–WAS) was initiated in 2003 to quantify the measurable environmental effects of conservation practices and develop the science base for managing agricultural landscapes for environmental quality. CEAP has grown to include 24 watershed studies and several special projects that include legacy nutrients, ephemeral gully erosion, as well as the development and assessment of conservation tools and models. Please join USDA's Natural Resources Conservation Service (NRCS) and Agricultural Research Service (ARS) and university CEAP scientists to celebrate 20 years of CEAP and learn about and discuss the many CEAP–WAS assessments conducted across the United States. This year's meeting will take place as a CEAP Showcase within the SWCS annual meeting on Tuesday, August 8, and feature three oral sessions and a poster session on Monday, August 7, and Tuesday, August 8, with presentations ranging in topics from quantifying the impacts of individual conservation practices to approaches, techniques, and processes for assessing conservation practices to the development and assessment of conservation tools and modeling. Please join us in celebrating 20 years of CEAP!

20 Years of Conservation Practice Assessments
10:30 AM – 12:00 PM

Moderator: *Kevin King, USDA ARS*

Presentation 1: Twenty Years of Conservation Effects Assessment in the St. Joseph River Watershed, Indiana - *Williams, M., S. Livingston, L. Duriancik, D. Flanagan, J. Frankenberger, R. Gillespie, J. Gonzalez, C. Huang, C. Penn, D. Smith, and C. Renschler*

The St. Joseph River is one of the main tributaries to the Maumee River and Lake Erie. The USDA Agricultural Research Service (ARS) National Soil Erosion Research Laboratory (NSERL) has been conducting cutting-edge research on water, sediment, nutrient, and pesticide losses from agricultural lands and testing novel conservation practices for decreasing these losses in the St. Joseph River watershed for the past 20 years (2002-2022). This article describes the history of the USDA ARS NSERL water quality monitoring, summarizes and highlights key research findings, and outlines successes, challenges and future directions of research. Key research findings include: 1) prevalence of pesticides in drainage water depends on the specific compound, season, and management practices; 2) subsurface tile drainage and drainage ditches play an important role in nutrient transport from agricultural landscapes; 3) blind inlets and phosphorus removal structures decrease sediment, phosphorus, and pesticide losses from tile-drained landscapes; 4) ecological assessments reveal the importance of habitat and water chemistry to aquatic organisms and how conservation practices can enhance aquatic biota abundance and diversity; and 5) computer simulation modeling at field and watershed scales shows the impact of conservation under current and future climates. With 20 years of research in the rearview mirror, the NSERL plans to leverage these long-term datasets to tackle both ongoing and newly emerging research questions such as climate change and legacy nutrients in the future.

Presentation 2: Beasley Lake Watershed: A Unique Lens to Study Environmental Integrity through 20 Years of CEAP - *Lizotte, R.E., M.A. Locke, L.M. Witthaus, J.M. Taylor, M.T. Moore, and L.J. Heintzman*

Conservation Effects Assessment Project (CEAP) has provided insight into the value of agricultural best management practices (BMPs) for the last 20 years. As a small watershed with about 17% of land in conservation practices, Beasley Lake Watershed (BLW) in western Mississippi, has provided a unique long-term dataset to assess improvements to water and soil quality. In-field soil sampling, edge-of-field water quality measurements, and a variety of lake water quality studies have allowed different lenses to study impacts of BMPs at various scales. Studies have evaluated effects of edge-of-field buffers, a Conservation Reserve Program (CRP) set-aside, a constructed wetland, wildlife habitat buffers, and a modified sediment retention pond on water quality and ecology. Runoff and lake surface water quality monitoring show reductions in sediments and nutrients resulting from long-term BMP establishment. Watershed soil quality assessments demonstrated improvements in soil health with implementation of buffers, CRP, and minimum tillage practices. Current studies provide insight into within-lake nutrient cycling and influence of legacy nutrients. Estimates of annual sediment release of NH4-N and PO4-P are substantial and may result in lagging water quality responses to management changes. These results contribute to improved lake watershed and water quality modeling. Integrating long-term monitoring datasets with short-term experiments is broadening our understanding of biogeochemical cycles in agricultural waterbodies and improving knowledge of mechanisms for water quality changes. Our results are critical to understanding how BMPs can improve watershed environmental integrity and providing decision tools for farmers, landowners, managers, and other stakeholders when implementing BMPs.

Presentation 3: Highlights of CEAP Activities and/or Outcomes in the Upper Washita Basin - *Moriasi, D.N., P.J. Starks, A.M. Fortuna, and J.L. Steiner*

The Fort Cobb Reservoir Experimental (FCREW) and Little Washita River Experimental (LWREW) watersheds, located within the Upper Washita Basin (UWB) in Oklahoma, have been part of the ARS Benchmark Conservation Effects Assessment Project (CEAP)-Watershed Assessment Studies since 2003. Presenting research findings based on applied conservation practices (CPs) and their scale is the goal of this presentation. The main factors that affect water resources and soil erosion in the UWB are climate, land use, and red cedar encroachment. No-till, riparian buffers, and red cedar removal were commonly implemented CPs to protect soil and water resources in this study. In 2012, bathymetric survey in the LWREW showed that the remaining service life of the reservoirs ranged from 45 to 118 years. Of these studies, 11 of 12 reservoirs reflected remaining service life of more 50 years due to multiple CPs implemented over the years through NRCS programs. A recent study that sought to identify correlations between soil health (phosphorus, available water content, sand to-clay ratio) and water quality (nitrates, electrical conductivity, total dissolved solids) indicators associated with land use, management, soil texture, aspect, elevation, and slope found that application of CPs in the FCREW for three years improved water quality. Details of the effects of other implemented CPs such as no-till, filter strips, and riparian buffers on soil and water resources will also be presented.

Presentation 4: Evaluating Water Quality Impacts of Agronomic and Conservation Management: 20 Years of CEAP at the Riesel Watersheds - *Smith, D.R., R.D. Harmel, C. Hajda, and K. Tiner*

The Riesel Watersheds, near Riesel, TX, have been used throughout the 20 year history of the Conservation Effects Assessment Project (CEAP) to evaluate the role of agronomic management and conservation practices on runoff water quality, as well as soil health, crop production, and profitability. This presentation will highlight findings from this work. During the first 15 years of CEAP poultry litter was applied to fields at Riesel at rates ranging from 0 to 13 Mg/ha. Agronomic production, water quality, and soil health were optimized with lower rates of poultry litter application (4.5-6.7 Mg/ha). Increasing time between litter application and rainfall tended to improve water quality, while using supplemental nitrogen fertilizer to balance crop demand with nutrient availability from poultry litter were the most viable options. Incorporation of cover crops coincided with NO3-N and NH4-N concentrations decreasing greatly, whereas there were increases in soluble P runoff during the same period. In 2018 precision agriculture and precision conservation were adopted. Soil health practices (no-till, cover crops, and reduced fertility rates) generally reduced sediment concentrations, although the lower

sediment concentrations coincided with greater runoff P concentrations. In crop year 2022, fallowing unproductive portions of two fields resulted in them going from losing money ($-37.82/ac and -28.63/ac annually) to revenue generators ($459.21/ac and $72.16/ac, respectively). This work shows the potential benefits and pitfalls associated with adaptive management and conservation with a goal of improving water quality and cropland productivity.

Approaches, Techniques, and Processes for Assessing Conservation Practices
1:30 PM – 3:00 PM

Moderator: *Lisa Duriancik, USDA NRCS*

Presentation 1: USDA Watershed Lag Time Project: Use of a Cropland Specific Transient Tracer for Characterizing the Hydrology of Agricultural Watersheds - *Owen, D.C., G.W. McCarty, C.J. Hapeman, C.P. Rice, W.D. Hively, R.E. Plummer, P.W. Downey, P.J. Rice, J.M. Baker, C. Simmerman, C. Baffaut, W.M. Olson, O. Pisani, T.C. Strickland, D.D. Bosch, K.J. Cole, K. Barnett, A. Stanfield, R.W. Malone, T.E. Gilmore, A. Mittelstet, S.K. Hamilton, D. Weed, K.R. Elkin, A.R. Buda1, T. Troutman, J.W. Faulkner, M. Kelting, L.T. Johnson, J. Boehler, K.W. King, D.L. Busch, M.W. Sandstrom, M. Riskin, and C.J. Lee*

The USDA Watershed Lag Time Project (WLTP) in conjunction with the Conservation Effects Assessment Project (CEAP) watershed network has worked to characterize fate of cropland influenced waters by tracing movement of the herbicide degradation product metolachlor ethane sulfonic acid (MESA) which acts as a conserved transport analog of nitrate-N. This technique makes use of a reformulation of metolachlor released to the US market in CY 2000 (an enantiomeric change from racemic to predominantly S-metolachlor). Chirality of the parent compound is retained in the MESA detected in the natural waters within watersheds. By quantifying the fraction of pre-2000 MESA, the amount pre-2000 cropland influenced water and nitrate in stream water can be determined. The WLTP includes 66 watersheds nationally, ranging from 7 km2 to nearly 3 million km2. The study spans 2+ years and has afforded over 1000 observations of MESA chirality. Results revealed the uniqueness in pathways of cropland influenced waters (e.g., tile drainage, irrigation) to that of the greater watershed and show a large range in pre-2000 MESA mean values and coefficient of variation for individual watersheds. Smaller watersheds typically displayed greater diversity with a wider range of mean values and sites with greater temporal variance, while both the range and temporal variance decreased at larger observation scales. Based on a first-order decay model, the observed watersheds had a median Mean Residence Time (MRT) of 11 years with a range of 4 – 29 years. However, these values are likely an upper bound estimates of actual MRT as various natural and engineered hydrologic processes will trend watershed dynamics toward a power law distribution. The tracer dynamics in these watersheds indicate the importance of land use specific tracers for characterizing watershed hydrology to reduce uncertainty associated with watershed models assessing fate of cropland influenced waters.

Presentation 2: Deciphering Flow and Transport Processes from the Land Surface to a Groundwater Well During Managed Aquifer Recharge - *Dahlke, H.E., T. Zhou, E. Levintal, G. Brunetti, S. Jordan, T. Harter, I. Kisekka, J. Šimůnek*

Agricultural managed aquifer recharge (Ag-MAR) is a method where large volume flows are spread on agricultural fields for groundwater recharge. Ag-MAR has the potential to offset groundwater depletion in many groundwater-dependent regions where flood flows are available for recharge, but risks such as the leaching of pesticides and fertilizers to groundwater create uncertainty for its widespread adoption. Leaching of residual soil nitrate from agricultural fields has led in many regions to elevated nitrate concentrations in groundwater, which pose a risk to public health. Leaching of nitrate or other harmful contaminants such as pesticide residues are

often mitigated by improving irrigation efficiency, hence, intentional flooding farm fields for recharge may accelerate the transport of contaminants through the vadose zone to groundwater. To answer this question, we conducted a high-resolution managed aquifer recharge experiment on a fallow field in the Central Valley, California. Three 0.3-hectare recharge plots were established located 5 m upgradient from three 30 m groundwater wells. Surface water was continuously recharged for 4 weeks and water flow, biogeochemical parameters, and bromide from a KBr tracer were continuously measured at five depths (0.2, 0.6, 1.0, 3.0, 5.0 m) in the vadose zone and the groundwater wells. To analyze the water balance, transit time and propensity for preferential flow we analyzed the field-observed moisture, Br-, and soil temperature data with a single porosity, uniform flow, and dual-porosity HYDRUS model. We found clear evidence of preferential flow in two of the three profiles likely caused by the combined effects of continuous ponded conditions, dry antecedent conditions, and high clay content. We further observed that the degree of preferential flow increased as depth increased as evidenced by the later arrival of the simulated wetting fronts than those observed. Due to the existence of preferential flow, the travel times of bromide from the soil surface through the soil profiles decreased by up to 23%, while the water flow velocity increased by up to 30% compared to the single porosity flow model. However, preferential flow did not have a significant impact on the water balance. About 64~68% of the applied water recharged the groundwater table.

Presentation 3: Field Scale Assessment of Nitrate Leaching to Groundwater in the Central Valley Aquifer System - *Kisekka, I., I. Raij-Hoffman, F. Ogunmokun, C. Bonfil, W. Lennon, O. Dahan, and T. Harter*

Nitrate contamination of groundwater is a major problem worldwide including in the United States. Innovative monitoring techniques are needed to assess the effectiveness of conservation practices e.g., 4R nitrogen management, irrigation scheduling, irrigation nitrogen credit, etc. The goal of the Central Valley field scale assessment CEAP project is to assess the effectiveness of conservation practices using three approaches of nitrate leaching monitoring including i) deep vadose-zone monitoring system (VMS), ii) groundwater monitoring, and iii) field-scale nitrogen balance assessments. Three sites with a VMS have been established in the Central Valley for three major crops including processing tomatoes, citrus, and almonds. In this presentation, I will focus on the processing tomato field site that was established earlier than the citrus and almond sites. The study was conducted in a commercial processing tomato field located in Yolo County in the Central Valley of California. Historic water and nitrogen mass balances were performed using grower information, remote sensing, meteorological data, and nitrogen uptake coefficients. From November 2019, water and nitrogen inputs and outputs were continuously measured and field-level water and nitrogen mass balances were performed. In addition, a deep VMS, as well as a network of groundwater monitoring wells, were installed in the 2020-2021 season and nitrogen movement was monitored from the root zone to the groundwater. We showed that the deep VMS technology was able to detect deep percolation and nitrate leaching following heavy rainfall from atmospheric rivers in the winter. The field mass balance approach provided comparable results to the VMS but with larger uncertainty. Similar monitoring protocols are being implemented at the citrus and almond sites, additional years of monitoring are needed to confirm if conservation practices adopted at these field sites reduce nitrate leaching to groundwater.

Presentation 4: The USDA Legacy P Project: Characterizing Sources and Forecasting Watershed Outcomes - *Pete Kleinman, Zach Simpson, Dave Bjorneberg, Kossi Nouwakpo, Chris Richards, Gary Feyereisen, Brent Dalzell, Lindsey Witthaus, Mark Williams, Chad Penn, Greg McCarty, Cathleen Hapeman, Kyle Elkin, Tony Buda, Joshua Faulkner, Teferi Tsegaye, Lisa Duriancik*

Legacy phosphorus, i.e., the anthropogenic phosphorus that resides in soils and sediments, can be an important source of fertility to crops and a saboteur of water quality mitigation efforts. The USDA Legacy P Project leverages experimental watershed participating in CEAP to characterize phosphorus sources and to model edge-of-field, watershed and regional outcomes of legacy P management. This presentation will provide an update on

soil and sediment characterization, long-term water quality data assessment, and modeling with APLE and SWAT at the seven sites participating in the project.

Development and Assessment of Conservation Tools and Modeling
3:30 PM – 5:00 PM

Moderator: *Dave Bjorneberg, USDA ARS*

Presentation 1: Adapting and Extending ACPF in the East: Water Quality Prediction and Conservation Practice Prioritization - *Duncan, J., C. Raj, A.N. Rohith, G. Saha, T. Veith, H. Preisendanz, D. Osmand, and P. Kleinman*

The careful application of precision conservation tools like the Agricultural Conservation Planning Framework (ACPF) holds great promise across varied agricultural landscapes of the Eastern US. First we tested input parameter sensitivity for six watersheds (two each North Carolina, Pennsylvania, and Vermont for multiple conservation practices in ACPF. We then discussed output with local and state NRCS and conservation district officials to examine the potential utility of the output as well as logistics of how to develop output on a broader spatial scale. Second, we created a framework to incorporate ACPF output into the Soil and Water Assessment Tool (Tool) to predict water quality impacts from conservation practices and based on the amount of pollutant reduction, prioritize which practice locations would be more effective. This workflow could be extended to other locations with existing models and ACPF output to help guide cost effective watershed management strategies.

Presentation 2: Choptank River Watershed: A Testbed for Development of Important Watershed Monitoring Tools - *McCarty, G.W., C.J. Hapeman, W.D. Hively, C.P. Rice, D.C. Owens, X. Zhang, and G.E. Moglen*

The Choptank River Watershed (CRW) became part of the Conservation Effects Assessment Project (CEAP) watershed network in 2005 and has been a test bed for major advancements necessary to improve monitoring, modeling, and management of agricultural watersheds. Project scientists, in collaboration with Maryland Department of Agriculture, developed a method using satellite data to monitor winter cover crop performance. The success of this research has led to operational use of remote sensing for management of the Maryland cover crop cost-share program, one of the most successful in the country. CRW research has also produced advancements in SWAT (Soil and Water Assessment Tool) model algorithms for better carbon accounting in agroecosystems. Other CRW research aspects involve intensive water quality monitoring. Results have demonstrated the importance of cropland specific transient tracers for understanding agricultural N fate in watersheds. Here, metolachlor ethane sulfonic acid (MESA) acts as a conserved transport analog of nitrate; its correlation with nitrate MESA in stream water can be used to assess the degree of nitrate export from croplands and biogeochemical processing within watersheds. Using archived water samples dating back to 2005, CRW researchers discovered the utility of the chiral signature of MESA to assess lag times between cropland management and changes in stream chemistry. This ability is based on the 2000 market release of the reformulated herbicide metolachlor from racemic to S-metolachlor. This chirality change is reflected in MESA allowing for measurement of pre-2000 fraction MESA in waters. The age fraction of MESA translates into age fractions of associated nitrate which led to the Watershed Lag Time Project (WLTP). Furthermore, chiral assessments of MESA in water can provide important information on the legacy N contribution to stream chemistry in agricultural watersheds. The WLTP is now being leveraged in the new CEAP Legacy N Project.

Presentation 3: A National SWAT+ Modeling Framework to support CEAP assessments - *Mike White, Jeff Arnold, Jungang Gao, Joon-Hee Lee, Marilyn Gambone, Natalja Čerkasova, James Chawanda, Katrin Bieger*

Many CEAP efforts include modeling to predict the impacts of current and future conservation strategies on soil and water resources. The Soil and Water Assessment Tool plus (SWAT+) model has been extensively used in CEAP's Cropland and Wildlife components in this capacity. SWAT+ is the culmination of more than 40 years of

water quality model development by USDA, and data collected from CEAP Watersheds have been used to develop and validate individual model algorithms. SWAT has been applied to thousands of watersheds in the US, but there is little consistency among these efforts in terms of scale, input data quality, operator skill, and scope, resulting in duplicative efforts and inconstant predictions. We developed the National Agroecosystems Model (NAM), a very detailed national SWAT+ model to provide a singular framework to support CEAP, LTAR, and other assessments. NAM contains 7 million computational land surface units, 3 million individually identifiable stream segments, and more than 5,000 reservoirs. NAM is developed using only public data and can be shared with other government agencies, universities, and other research groups. Individual models are available for each 8-digit Hydrologic Unit Code (HUC) in the contiguous US.

Presentation 4: Adjustment of the Soil Vulnerability Index Classification to account for precipitation - *Baffaut, C., A. Thompson, and Q. Phung*

The Soil Vulnerability Index (SVI) developed by NRCS uses available soil properties from the SSURGO database to classify agricultural land into four levels of vulnerability to sediment and nutrient losses: low, moderate, moderately high, and high. It includes multiple components, including the runoff component, which is based on the risk of sediment from cropland being discharged into the streams. Improvements in assigning vulnerability classification by including rainfall characteristics have been suggested. The objective of this research was to evaluate rainfall characteristics on the runoff component of SVI, with the goal to improve SVI vulnerability classification. The study simulated sediment yields using three calibrated models developed with the Soil and Water Assessment Tool (SWAT). These models represent three Conservation Effects Assessment Project (CEAP) watersheds having a range of physiographic and hydrologic characteristics in Missouri, Ohio, and Pennsylvania. Sediment yields from these watersheds were simulated using precipitation data from 1985 to 2014 from 11 different CEAP watersheds spanning Texas to Vermont, Georgia, and Mississippi. Classifications based on simulated sediment yields were evaluated across a range of landscape slopes. Results indicate that the risk of sediment discharge into the streams can shift up or down due to precipitation amount, intensity, and R-factor, and this shift is more pronounced for steeper slopes. The changing sediment loss is better correlated with precipitation characteristics in northern than in southern states. Possible modifications in the SVI classification rule-set to account for these differences are proposed.

How Much Topsoil Do We Have, and Can We Protect and Build Topsoil Before It Disappears?
Room 304 on Main Level

Track: Climate-Smart Agriculture

Time: 10:30 AM – 12:00 PM CT

Moderator: *Daniel P. Zinkand, DZC, LLC*

Presenters: *Rick Cruse (Iowa State University); Tim Recker (J&T Farms); Bruce Rohwer (Dry Run Drainage, Ltd)*

The I-80 Adair-Casey (eastbound) rest stop about halfway between Des Moines and Omaha-Council Bluffs pays tribute to both Iowan Henry A. Wallace, who grew up on a family farm in the area and served as Secretary of Agriculture and to Iowa agriculture. But before visitors see and read the extensive historical tributes to Wallace and to Iowa agriculture, they will walk by five columns that depict Iowa's topsoil declining from an average statewide of around 16 inches when settlers began farming in 1850 to less than six inches in the early 2000s. One visitor -- an Iowa agronomist -- later blogged that the trend of declining soil from 1850 to about 2005 could lead to the disappearance of Iowa's topsoil entirely by 2093! The trend on Iowa's topsoil, along with the disruption in corn, soybean, and sunflower production and exports from Russia and Ukraine due to the war, raises important questions for farmers, landowners, and for national and international security. This Symposia will address: 1) How much topsoil is left not only in Iowa but also in the CornBelt, an issue highlighted by the 2021 National Academies of Sciences' study that estimated 35 percent of the CornBelt's topsoil had disappeared. 2) What farmers are doing with less tillage (no-till, conservation tillage), cover crops, and other practices to protect topsoil and improve productivity. 3) The Return on Investment of less tillage, leaving more crop residue, and deploying cover crops.

Exploring Crop Diversification with Perennial Bioenergy Crops: How to Conduct Meaningful Outreach and Engage Farmers
Room 305 on Main Level

Track: Conservation Models, Tools, and Technologies

Time: 10:30 AM – 12:00 PM CT

Moderator: *Marlee Giacometti, American Farmland Trust*

Presenters: *John Quinn (Argonne National Laboratory); Brad Kasberg (Argonne National Laboratory); Marlee Giacometti (American Farmland Trust); Shelby Best (American Farmland Trust)*

Perennial bioenergy crop production has the potential to provide sustainably produced feedstocks for renewable energy, and fuel sources used both on- and off-farm. The adoption of perennial bioenergy cropping systems offers farmers an opportunity to diversify the region's landscape, achieve nutrient loss reduction goals, and boost overall resiliency and profitability. Integrating perennial bioenergy cropping systems into traditional commodity crop production systems can help farmers leverage new economic opportunities and environmental benefits on marginal farmland.

American Farmland Trust (AFT) is working with Argonne National Laboratory on a 3-year project to explore the use of perennial bioenergy crops on marginal land in the Midwest. The first part of the project has resulted in a wealth of qualitative data gained from surveys, listening sessions, and stakeholder interviews.

To support the project, AFT created an outreach opportunity assessment and outreach and engagement strategy for providing technical assistance to farmers interested in adopting perennial bioenergy crops. Data has also come from Argonne's Scaling Up Perennial Bioenergy Economics & Ecosystems Services Tool (SUPERBEEST) to determine the best areas suitable for bioenergy feedstock production. These results have informed outreach for this project to specific geographies suitable for adoption while reaching historically underserved producers.

During this 90-minute symposium, AFT & Argonne will: 1) provide a project overview, highlighting its outreach & engagement strategy as it relates to project goals and objectives, 2) introduce three perennial bioenergy crops and discuss end use opportunities to provide economic support to farmers, and 3) host a panel discussion where research experts and farmers (listed below) will share their experiences studying and producing perennial bioenergy crops. Collectively, this session will help inform future technical assistance and crop diversification efforts across the Midwest.

Panelists*:

- *Colleen Zumpf, Post-Doctoral Researcher, Argonne National Laboratory*
- *Eric Rund, Miscanthus Farmer & Owner, Green Flame Energy*
- *Tim Mies, Researcher, University of Illinois Urbana-Champaign*
- *John Quinn, Principal Hydrogeologist, Argonne National Laboratory*

**This is a tentative list; panelist names may be subject to change*

Cultivating Action: How Do Women Take Conservation Action?
Room 306 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 10:30 AM – 12:00 PM CT

Moderator: *Jean C. Eells, E Resources Group, LLC*

Presenters: *Linda Shenk (Iowa State University); Stephanie Enloe (Women, Food and Agriculture Network); Rebecca Christoffel (Christoffel Conservation); Sharon Chism (CCA, farmer); Joan Countryman (out-of-state landowner)*

This symposium brings together researchers and conservation practitioners from three related projects who have developed strategies for empowering women as particularly powerful, but under-recognized leaders in stewarding the land and water with a legacy mindset. We hope these insights can inform future research projects about designing policies and programs to include and engage women who have not yet taken up conservation action. Survey questions often miss women's perspectives because the nuances of women's approaches to land management aren't well known. Conservation program participation by women is often uneven for reasons that seem mysterious to those of us steeped in conservation culture.

One featured project examined women's stories and the use of relationships that we learned by working with women organized into learning cohorts. As co-researchers, the women showed us their action timelines, what actions they undertook, and what matters to them about their land. Pollinator habitat is popular with women landowners, so in a second project, we skipped the sales and paired them with planners to help them get the acres into a habitat, with interesting results. Lastly, a multi-year project will share findings from early work to learn about what was truly important to women about the outreach opportunities presented and how to more effectively help women get conservation plans made that are actionable for agency funding.

This symposium will have three presentations, each with a short Q&A. We will emphasize collective discussion time about the implications these insights have for research designs for conservation practices and social science, and what aspects of policies and rules might help or discourage women from acting. Presenters are from the Women Food and Agriculture Network, E Resources Group, LLC, and Iowa State University.

Equipping Next-Gen Ag and Conservation Professionals

Updated Title: Personal Reflections on the Cultural Roots of Conservation: Connecting Past to Future in Shaping a Legacy of Sustainability in Agriculture

Room 307 on Main Level

Track: Outreach, Education, and Community Engagement

Time: 10:30 AM – 12:00 PM CT

Moderator: *Erin Meier, Green Lands Blue Waters*

Presenters: *Lia Carrillo, Forestry Student, Iowa State University; Guolong Liang, Agriculture Water Quality Outreach Specialist, University of Wisconsin-Madison, Division of Extension; Gurparteet Singh, Graduate Research Assistant, University of Minnesota, Department of Soil, Water and Climate; Aaryn Wilson, Incoming Graduate Research Assistant (currently living in Minnesota), University of California - Merced, Department of Environmental Systems*

We are faced with the complex challenge of nourishing people while also nurturing the land that sustains us. The next generation of agricultural and conservation professionals will need to draw from a diverse set of perspectives and experiences to envision, embrace, and effectuate landscape-scale transformation and truly set us on the path of agricultural sustainability.

Green Lands Blue Waters and the Mississippi River Network received a 2022 NRCS Equity Conservation Agreement to launch a mentorship program - see https://greenlandsbluewaters.org/next-gen-ag-leaders/.

Four early-career cohort members will reflect on their cultural heritage and family histories that cultivated their unique connections to natural resources and agriculture. This panel will share how multigenerational wisdom and regional contexts may shape the modern sustainable agricultural tapestry and how these perspectives can contribute to a more inclusive, sustainable future in food production and natural resource conservation.

Understanding Retention of Cover Cropped Acres: A Midwestern Watershed Scale Case Study
Room 305 on Main Level

Track: Adaptive Management of Conservation Efforts

Time: 1:30 PM – 3:00 PM CT

Moderator: *Seth Harden, The Nature Conservancy*

Presenters: *Seth Harden (The Nature Conservancy); Leslie Fisher (Benton Co. Soil and Water Conservation District and Big Pine Creek Watershed Project); Shalamar Armstrong (Purdue University); Kanru Chen (Purdue University); Linda Prokopy (Purdue University); Emily Usher (Purdue University)*

Emphasis and investment are often placed on the recruitment of new acres to conservation practices (BMPs). By design, this is how emerging carbon and traditional government programs measure success. There is much scholarship on farmer behavior and conservation adoption, but the scholarship studying retention of BMPs is limited. This leads to gaps in understanding of long-term outcomes of conservation cost-share programs and ROI for education and technical assistance. Due to the proximity of Purdue University, the level of investment ($7.5M (RCPP, MRBI, 319)), and a decade of implementation, the Big Pine Creek watershed (BPC) in Indiana has become a proving ground for the advancement of social, economic, and technological conservation solutions. Via two methods, BPC project partners are studying cover crop acre retention to ensure enduring and sustained environmental outcomes. Ongoing qualitative research shows that producers who continue the use of cover crops after cost-share funding ends can be characterized by a commitment to stewardship, a learning mentality, and a perception that cover crop benefits outweigh management challenges. Results also indicate that cost-share program rates, program length, and lack of program flexibility can limit the continued use of cover crops. Separate research using remote sensing technology assessed cover crop adoption and tenure over an eight-year period (2014-2021) in the BPC project geography. In the first five years, a 5-6% increase was observed in total cover crop acres annually. However, it was determined that less than 3% of acres in the watershed utilized cover crops in consecutive years across the 5-year period. In years 6-8, a reduction in total cover crop acres was observed, correlating to the end of 3-year cost-share contracts. The combined outcomes of spatial and social research result in a watershed-level interdisciplinary case study critical to improving policy and process to drive systematic long-term change in the Midwestern landscape.

Accelerating Conservation Drainage in Iowa Using the Batch and Build Model
Room 306 on Main Level

Track: Climate-Smart Agriculture

Time: 1:30 PM – 3:00 PM CT

Moderator: *Keegan J. Kult, Ag Drainage Management Coalition*

Presenters: *Keegan Kult (Agricultural Drainage Management Coalition); John Swanson (Polk County Public Works Department); Ruth McCabe (Heartland Co-op); Tanner Puls (Statewide Edge of Field Coordinator, IDALS, Water Resources Bureau); Clint Miller (Polk County, USDA-NRCS)*

This symposia explores scaling up conservation drainage practices in Iowa via the Batch and Build procedural model. Batch and Build is an innovative approach to organizing the construction of multiple edge-of-field structural practices within the same watershed, and then batching them together as a single project with a single administrative entity. This multi-layered planning process brings together funding and programming knowledge from an array of stakeholders and conservation professionals. Each speaker will discuss their company's or agency's roles and programming responsibilities for implementing the process and their collaborative needs for further development of the Batch and Build model.

Topics in Conservation History and Education
Room 307 on Main Level

Track: Social Sciences Informing Conservation

Time: 1:30 PM – 3:00 PM CT

Moderator: *Joe Otto, Soil and Water Conservation Society*

Presenters: *Anthony Carlson (US Army's School of Advanced Military Studies); Shelby Callaway (USDA-NRCS); Josh Nygren (University of Central Missouri); Brian Rumsey (University of Northern Iowa)*

This symposia brings together experts from the social science disciplines to discuss conservation topics, both past and present. The first speaker will discuss the development of federal conservation programming in the early 20th century. The second speaker will discuss equitable access to careers in conservation during the early years of the Soil Conservation Service. The third speaker will discuss twenty-first-century federal conservation programming considering the agencies' founding priorities and values. The final speaker will discuss a practitioner's perspective of educating young people about topics in conservation agriculture and sustainability in 2023.

Updates from the DiverseCornBelt: Enhancing Rural Resilience through Landscape Diversity in the Midwest
Room 304 on Main Level

Track: Adaptive Management of Conservation Efforts

Time: 3:30 PM – 5:00 PM CT

Moderator: *Emily M. Usher, Purdue University*

Presenters: *Linda Prokopy (Purdue University); Benjamin Gramig (USDA Economic Research Service); Katherine Pivaral (Purdue University); Lauren S. Asprooth (University of California, Davis); Kristin Floress (US Forest Service); Philip W. Gassman (CARD, Iowa State University); Keith Schilling (Iowa Geological Survey); Silvia Secchi (Dept. of Geographical and Sustainability Sciences, University of Iowa)*

The corn and soybean monoculture has dominated Midwestern agriculture for decades and is ingrained in our supply chains, infrastructure, and federal and state policies. While this pattern provides benefits for some, it has resulted in decreased economic opportunities, declining rural communities, and degraded environments. To address these challenges, the Diverse Corn Belt (DCB) – a five-year USDA-NIFA-funded project – is working to develop an evidence-based framework and vision for a more diverse agricultural landscape across the Midwestern Corn Belt (Illinois, Iowa, and Indiana). We propose that given the right enabling conditions, diversified farms, markets, and landscapes can generate a broader range of economic, social, and ecosystem benefits than the dominant corn and soybean system. Using an integrated and transdisciplinary approach, the DCB team is conducting a systemic analysis and assessment of viable pathways to enable a more diversified agricultural landscape across the Corn Belt.

This symposium will provide an overview of challenges associated with the corn and soybean monoculture, share coproduced insights on environmental costs and benefits of diversified systems, and explore socioeconomic factors impacting the adoption of diverse and sustainable practices across the agricultural value chain. The symposium will also include a Q&A session to discuss how interdisciplinary work can inform pathways to implementation.

The Benefits of Carbon and Soil Health Programs to Meet Local Resource Concerns
Room 305 on Main Level

Track: Climate-Smart Agriculture

Time: 3:30 PM – 5:00 PM CT

Moderator: *Meg Leader, NACD*

Presenters: *Meg Leader (NACD); Tim Palmer (Madison County SWCD); Mahdi M. Al-Kaisi (Iowa State University)*

A panel presentation with representatives that include a producer, a national conservation organization, a university researcher, and a carbon market. The panel will discuss how carbon market participation allows the fulfillment of local and national water quality goals while having a positive effect on climate.

Carbon markets are based on soil health and include diversified production systems, including extended crop rotations and livestock. Over the last few years, carbon markets have moved from experimental test projects to functioning markets. In its current state, it is a confusing mix of programs and offerings where each appears to have its own rules and payment rates. Local conservation staff are left struggling to understand as they try to encourage producer participation.

It is easy to be lost in the carbon market details and end up seeing expanding producer participation as another task outside of District/State/Federal programs to get conservation on the ground. For many local staff, busy with their own responsibilities, promoting and supporting carbon market participation is lost behind familiar programs.

This panel discussion will tie the results of carbon market participation expansion with the ability of local staff to address their organization's current strategic plans and mission goals. The speakers will each draw on their own experiences to shift the framing of carbon market participation from a new task that takes away from current programs to one of many tools local staff can use to improve water and soil quality within their own communities.

Investing in People to Improve Watersheds
Room 306 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 3:30 PM – 5:00 PM CT

Moderator: *Jenny Seifert, University of Wisconsin-Madison Division of Extension*

Presenters: *Jenny Seifert (University of Wisconsin-Madison Division of Extension); Amanda Gumbert (University of Kentucky); Catherine DeLong (Iowa State University Extension and Outreach); Craig Ficenec (Sand County Foundation)*

Science shows that the single greatest indicator of conservation practice adoption by farmers is sustained interaction with a conservation professional. People and relationships - human and social capital - are foundational to achieving soil and water conservation goals. Yet, investments in people lag investments in research, technology, and practices, often undermining success.

At the watershed scale, watershed coordinators and similar practitioners are critical connectors and implementers, whose fundamental role is relationship management. However, watershed practitioners often feel isolated in their roles, are under-compensated, and can get overwhelmed by the demands of the job, leading to high turnover, disrupted relationships, and thwarted success.

This symposium will make the case for investing in people to improve watersheds and explore the importance of peer learning and professional development. We will share how we are developing a community of practice through an online community and virtual meet-up series, both organized by The Confluence for Watershed Leaders, to help watershed practitioners feel better connected and supported. We will also hear what Leadership for Midwestern Watersheds is learning about professional development needs, the value of network building, and the funding and employment landscape for watershed coordinators. Finally, we will share lessons from Iowa State University Extension and Outreach's Watershed Academy and Land Stewardship Leadership Academy about how these programs are meeting the evolving needs of watershed practitioners. Our discussion will also include a boots-on-the-ground watershed practitioner who has benefitted from this programming. We will culminate with a participatory discussion about the need for investing in people in watershed management and how we can all work to meet those needs.

Understanding a Midwestern Watershed: An In-Depth Analysis of a Farmer-Led Watershed Group Support, Student Water Quality Monitoring, Human Dimensions Analysis, and Hydrologic Impacts in the Shell Creek Watershed
Room 307 on Main Level

Track: Water Resource Assessment and Management

Time: 3:30 PM – 5:00 PM CT

Moderator: *Katie Pekarek, University of Nebraska*

Presenters: *Katie Pekarek (University of Nebraska); Shivendra Srivastava (University of Nebraska-Lincoln); Ryan Chapman (Lower Platte North NRD); Matt Bailey (Shell Creek Watershed Improvement Group); Mark Seier (Newman Grove Public School)*

The Shell Creek watershed is a rural watershed in Nebraska with a history of chronic flooding, soil erosion, and poor water quality. Concerns about these issues led a group of farmers to form a grassroots organization called the Shell Creek Watershed Improvement Group (SCWIG). This group promoted conservation practices for 20+ years, in partnership with local, state, and federal agencies. Recently, Shell Creek was delisted for Atrazine, possibly because of increased conservation.

This symposium offers an in-depth analysis of

1) the functionality, conservation actions, and impact of SCWIG. This includes identifying the needs & challenges of the group, the approach to promoting conservation adoption amongst farmers, and the role of partnerships in financial & technical support.
2) student water quality monitoring by Newman Grove students. Students will give detailed descriptions of the history of developing the volunteer program, the water quality analysis being conducted, and associated outreach and education efforts.
3) Shell Creek watershed producer perceptions of water quality and attitudes to conservation practices. All producers (886) in the watershed were surveyed, with 22% (n=194) responding, and 17.7% of respondents very concerned about water quality impacting their farm. 79.9% of respondents are implementing no-till, and 31% are implementing cover crops, although most do not consider themselves early adopters of conservation (88%).
4) the use and impacts of conservation practices on flooding in the watershed by using a high-resolution remotely sensed conservation practice dataset (1990-2020) to understand the use of conservation practices including reduced or no tillage, cover crops, and crop rotations in this watershed. It uses Fast Causal Inference (FCI) and Fast Greedy Equivalence Search (FGES) to assess the cause-and-effect relationships between the implementation of different conservation practices and water quantity & quality variables.

WEDNESDAY, AUGUST 9

SYMPOSIA SESSION DESCRIPTIONS AND AGENDA

USDA Climate Hubs: Translating Science into Action for Climate-Smart Agriculture and Decision-Making
Room 312 on Main Level

Track: Conservation Models, Tools, and Technologies

Time: 8:30 AM – 10:00 AM CT

Moderator: *Julian Reyes, USDA Climate Hubs*

Presenters: *Andres Cibils (USDA Southern Plains Climate Hub); Nora Alvarez (USDA Caribbean Climate Hub); Dennis Todey (USDA Midwest Climate Hub); Laurie Nowatzke (USDA Midwest Climate Hub); Maria Janowiak (USDA Northern Forests Climate Hub)*

The U.S. Department of Agriculture (USDA) Climate Hubs develop and deliver science-based information and technologies to natural resource and agricultural managers to reduce agricultural risk and build resilience ultimately to support climate-smart agriculture and forestry (CSAF). The Climate Hubs leverage USDA investments to co-produce useful and usable information with farmers, ranchers, forest landowners, extension, and communities. By doing so, the regional Hubs connect research to practice, reducing the vulnerability of productive working lands to long-term climate change and extreme weather events. The Climate Hubs work closely with federal partners, extension, and trusted community partners to develop and deliver relevant and credible climate information. With their focus on knowledge sharing, the Climate Hubs bring lessons learned back to USDA agencies and their partners and complete a cycle of learning and improved preparedness which can enhance resilience and productivity.

Stakeholders drive tool and technology development, ensuring user-driven, decision-relevant information. The Hubs also provide coordinated technical support in adaptation planning to supplement USDA agriculture and land management program delivery. Here, we provide an overview of the Climate Hubs' co-production process, share lessons learned in working with communities and government partners, and highlight significant tools and technologies. We briefly highlight the development, application, and evaluation of our flexible Adaptation Menus designed for multiple sectors, freeze date and soil temperature visualization tools, educational modules, and peer-to-peer learning networks. Through tool co-development and curation alongside technical support and implementation, the Climate Hubs address regional partner needs and reduce obstacles to implementing CSAF practices.

Municipal-Agriculture Partnerships: A Tale of Three Cities
Room 313 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 8:30 AM – 10:00 AM CT

Moderator: *Heidi M. Peterson, Sand County Foundation*

Presenters: *Bartlett Durand (Sand County Foundation); Craig Ficenec (Sand County Foundation); Todd Peterson (Sand County Foundation); Three representatives of varied Iowa cities*

Watershed partnerships between municipalities and upstream farmers provide an opportunity to build trust between stakeholders and create a shared commitment to achieving water quality goals. Since farmers are not regulated under state water quality permits, states can create incentives for cities to enlist farmers to contribute to their sewage treatment permit compliance. Conservation of farmland generates nutrient reduction outcomes, which can be paid for in advance by, or sold to, nearby cities, towns, utilities, and industrial permittees that need to meet their permit obligations. In addition to cost savings, environmental benefits are achieved. In the absence of other state regulation or policy, such as exists in Wisconsin, Memoranda of Understanding are a valuable way to create enough certainty to enable cities and utilities to invest and the State Clean Water Act Administrator to accept these approaches.

Since 2017, Sand County Foundation has been negotiating with Iowa DNR to create a legal mechanism to allow municipal permit compliance through conservation adoption on watershed farms. Many organizations have been engaged in Iowa (and other states) to document the quantifiable water quality benefits that can come from farm-based practices. Our work in Iowa has focused on the legal agreement – a Memorandum of Agreement – that gives a city predictability that the money they invest in the watershed will be recognized by the state and that water quality outcomes will be valued using an agreed-upon model. This symposium will discuss the regulatory backdrop of the Clean Water Act, the interplay of agriculture-based practices and the potential for conservation to act as an offset for municipalities, and the general cost-benefit of a landscape approach versus a gray infrastructure approach. We will highlight the role of water professionals, conservationists, and conservation agronomists in working together to build out a partnership focused on a shared water resource.

Women Influencing USDA's Climate Response
Room 314 on Main Level

Track: Outreach, Education, and Community Engagement

Time: 8:30 AM – 10:00 AM CT

Moderator: *Christine Hall, WiN*

Presenters: *Katrina Thompson (WiN); Tina Jerome (WiN)*

Gain insight into how women in USDA influence agriculture climate literacy and coordinate action across the agencies. USDA's climate response is in the spotlight. Learn how women are leading efforts to increase climate literacy among USDA employees and stakeholders, as well as coordinate action across the agencies. Hear directly from women leaders on climate science, mitigating climate change, and adapting to its impacts in agriculture and forestry.

A Science-Based Framework to Scale Soil Health Assessment: Standardized Procedures, Recommended Measurements, and Local Interpretations
Room 315 on Main Level

Track: Soil Health Resources, Indicators, Assessment, and Management

Time: 8:30 AM – 10:00 AM CT

Moderator: *Adebukola Dada, Soil Health Institute*

Presenters: *Emily Bruner (Soil Health Institute); Nara Cloutier (Soil Health Institute); Adebukola Dada (Soil Health Institute); Minerva Dorantes (Soil Health Institute)*

Measuring management-induced changes in soil health can provide insight into farmers' progress at establishing more regenerative systems and guide place-based selection of practice changes that promote enhanced ecosystem processes and services. Informing stakeholders on how soil health management practices affect a soil's ability to support biomass production; store, filter, and transform nutrients and water; host biodiversity; and regulate carbon pools is essential to enabling informed decisions about practice selection and management.

The Soil Health Institute (SHI) recently announced a cost-effective, minimum suite of soil health measurements for scaling soil health assessment, including soil organic carbon concentration, carbon mineralization potential, and aggregate stability. This minimal suite of soil health indicators is expected to increase the number of stakeholders capable of quantitatively testing and monitoring their soil, which in turn may increase adoption of management practices that result in healthier soils.

During this 90-minute symposium we will: 1) provide an overview of SHI's recommended measurements for scaling soil heath assessment, 2) summarize practical considerations for designing sampling plans to assess soil health at field, farm, and regional scales, and 3) share insights from our work to inform locally relevant soil health data interpretation and establish achievable Soil Health Targets. Collectively these sessions will outline a scalable, science-based framework to measure and monitor soil health that can be implemented across a wide range of soil types, geographies, and production systems.

Opportunities for Climate Smart Agriculture to Produce Scope 3 Impact Units
Room 312 on Main Level

Track: Climate-Smart Agriculture

Time: 10:30 AM – 12:00 PM CT

Moderator: *Jack Jeworski, Ecosystem Services Market Consortium*

Presenters: *Jack Jeworski (ESMC); Steve Rosenzweig (General Mills); Thayer Tomlinson (ESMC)*

ESMC launched Eco-Harvest, a national ecosystem services market program for agriculture, in 2022. Eco-Harvest pays ag producers for quantified, verified, and outcomes-based soil carbon, greenhouse gas, water quality, water conservation, and biodiversity. Scope 3 impact units generated from climate-smart agricultural practices. Eco-Harvest is the only accredited ag supply chain market program.

Since 2020, ESMC has undertaken pilot projects to test program details – including soil sampling, MRV system development, and enrollment training to ensure both producers and buyers can participate in and offer feedback. ESMC continues to grow the available program offerings, including eligible practices, program regions, and crop types. Additionally, ESMC is working with corporate supply chain companies, such as General Mills, to ensure the impact units produced can be used to meet Scope 3 corporate supply chain goals set by food companies.

This symposium will highlight three years of programmatic lessons learned working with producers in a range of production systems and through eligible practices such as reduced tillage, cover crops, nutrient management, edge-of-field buffers, biodiversity planting, and more. It will include a panel discussion on opportunities to participate in Scope 3 ag supply chain markets, highlighting the benefits for both producers and food and beverage companies.

Enrolled producers play an important role in improving agricultural system resilience and mitigating climate change while being recognized and paid for their services. These producers often have questions about carbon and ecosystem services markets and how they can participate. This session will provide clarity on what producers (and those working with producers) should know before enrolling in these programs, how these markets can leverage the expertise of local conservation districts like SWCS, and how conservation districts can receive funding to support on-the-ground assistance.

Climate Change Impacts on Soil, Water, and Biodiversity Conservation
Room 313 on Main Level

Track: Conservation Economics and Policy

Time: 10:30 AM – 12:00 PM CT

Moderator: *Jean L. Steiner, Kansas State University*

Presenters: *Jean L Steiner (KSU); Xiaomao Lin (Kansas State University); Nancy Cavallaro (USDA NIFA (retired)); Gretchen Sassenrath (Kansas State University)*

In the past year, we witnessed severe floods and droughts on all continents of the globe, often with the same region experiencing drought followed by flood. While climate change impacts vary from country to country, loss, and damage, include degradation of soil, water, and biodiversity resources. With the pressures of increasing human population facing increasing challenges of climate change, the threats to the natural resource base, global food security, and the world's ecosystems have never been greater. For decades, the Soil and Water Conservation Society has raised the alarm about the threats of climate change to our natural resource base and the people and ecosystems reliant on that resource base. This symposium will present key findings from the recent special issue of the *Journal of Soil and Water Conservation* that was developed to advance understanding of the soil-water-climate systems and technologies and policies that can improve the resilience of the agro- and natural ecosystems.

STRIPS: 15 Years of Research and Implementation
Room 314 on Main Level

Track: Edge-of-Field Practices and Monitoring

Time: 10:30 AM – 12:00 PM CT

Moderator: *Tim Youngquist, Iowa State University/STRIPS*

Presenters: *J Arbuckle (Iowa State University); Douglas Davenport (USDA-NRCS – retired); Craig Ficenec (Sand County Foundation); Matt Helmers (Iowa State University); Marshall McDaniel (Iowa State University); Andy Olson (University of Northern Iowa, Tallgrass Prairie Center); Matthew O'Neal (Iowa State University); Lisa Schulte-Moore (Iowa State University); Haleigh Summers (Iowa State University); Matt Stephenson (Iowa State University, Bioeconomy Institute); Tim Youngquist (Iowa State University)*

STRIPS (Science-based Trials of Row crops Integrated with Prairie strips) began as an idea among a group of researchers at Iowa State University in 2004. The first prairie strips were seeded on small, agricultural catchments at the US Fish and Wildlife Service's Neal Smith National Wildlife Refuge near Prairie City, Iowa in the summer of 2007. In the 2018 Farm Bill, prairie strips were included as a standalone practice within the Farm Service Agency's Conservation Reserve Program "CP43" and are now seeded on over 15,000 acres nationwide.

This symposium will highlight advances made in both research and implementation, as told by both the original members of the STRIPS team and current students, with time for questions and discussion.

Prairie strips are a proven agricultural conservation practice that provides disproportionate benefits when planted in an agricultural landscape. Prairie strips are designed to alleviate environmental damage and biodiversity loss associated with row-crop agriculture. When strategically placed within agricultural fields, prairie strips can increase soil health, increase water infiltration, increase wildlife habitat, and decrease nutrient export. Diverse, native grass, legume, and forb species are used in the seed mix. They can be applied in a variety of ways, both at the edge and throughout a row crop field.

This is a research project that spans multiple disciplines, universities, and states. Throughout the last 15 years, the research team discovered that converting 10 percent of a row crop field into prairie can reduce by 95 percent the amount of soil and sediment leaving the field. Phosphorus loss decreased by 90 percent, and nitrogen loss by 85 percent. The prairie also created a habitat for birds, pollinators, and other wildlife.

Assessing Soil Health on Range and Pasture
Room 315 on Main Level

Track: Soil Health Resources, Indicators, Assessment, and Management

Time: 10:30 AM – 12:00 PM CT

Moderator: *Stanley Boltz, USDA-NRCS*

Presenters: *Stan Boltz (USDA-NRCS, Soil Health Division); Tanse Herrmann (USDA-NRCS, South Dakota); Greg Brann (USDA-NRCS, Soil Health Division (Retired - ACES))*

USDA/NRCS Soil Health Division's Technical Note "Cropland In-Field Soil Health Assessment Guide" (CIFSHA), provided a national, uniform method of assessing soil health on cropland. A similar, specific assessment has not yet been developed for range and pasture. However, there are existing, established assessments (e.g., Interpreting Indicators of Rangeland Health, Determining Indicators of Pasture Health, and Pasture Condition Scoring) which either have already included relevant parameters related to key soil health factors, or in one case, the existing assessment has been recently modified to include soil health evaluations. By completing these assessments on range and pasture following the existing methodology, and by focusing additional effort on specific parts of the assessments, the land manager will obtain applicable soil health information similar to what is obtained through CIFSHA. While a field assessment will not replace soil sampling and laboratory analysis in any case, these existing and modified assessments on range and pasture provide valuable and relevant information for a land manager to make informed decisions to effects soil health. This presentation will provide an understanding of when and how to use currently available range and pasture assessments to inform and support management of soil health.

ORAL PRESENTATIONS

MONDAY, AUGUST 7

ORAL PRESENTATION DESCRIPTIONS AND AGENDA

Subject: Conservation Models, Tools, and Technologies

Location: Room 313 on Main Level

Time: 10:30 AM - 12:00 PM

Combining Nutrient Trends Analysis at Long-Term Water Quality Monitoring Stations with Great Lakes to Gulf Conservation Data Layers to Visualize the Effects of Nutrient Reduction Strategies in the HTF States.

Authors: *Ellen Gilinsky (Ellen Gilinsky, LLC)*; Alejandra Botero-Acosta (Saint Louis University); Jong Lee (NCSA - University of Illinois); Richard Warner (University of Illinois - NGRREC); Laura Kammin (National Great Rivers Research and Education Center); Max Burnette (NCSA-University of Illinois)*

To successfully evaluate progress on nutrient reduction within the Mississippi River basin, there must be agreement on the metrics that will be used to track success. Selecting a network of existing long-term water quality monitoring stations as trend sites and using a unified analysis method can help achieve that goal and greatly simplify the exploration of nutrient trends across states and watersheds for the average user. The Great Lakes to Gulf Virtual Observatory (GLTG) is an interactive geospatial application focusing on the Mississippi River watershed that integrates water quality data and analytics from multiple sources. A recent GLTG project has developed GLTG visualizations of flow-normalized nutrient trends within sub-watersheds of the Mississippi River for the period of October 2002 through the present. This work has involved an in-depth analysis and harmonization of nitrogen and phosphorus data at over 300 sites, as well as calculation of the flow contributing to each site. The result is a robust data set consisting of about 300 monitoring stations that have measurements for over 70% of the period of record. From this data set, trends in nutrient concentrations and loads at each site can be calculated using Weighted Regression on Time, Discharge, and Season (WRTDS). These trends can then be coupled with geospatial datasets and state-reported progress outcomes of conservation practices to look for correlations that can help us understand how these practices are translating to nutrient reductions over time. This type of accounting can help inform the success of certain conservation practices over space and time and serve as a decision support tool that can relate management actions directly to water quality in the Mississippi River Basin.

Identification of Mechanisms Influencing Nutrient Transport on Upland Areas

Authors: *John E Gilley (USDA-ARS)**

The mechanisms influencing phosphorus (P) and nitrogen (N) transport in upland areas were identified using previously reported nutrient transport and runoff information. The data which was examined was obtained from field rainfall simulation studies evaluating the effects of varying runoff rates on P and N transport from either 2 or 4 m long plots located on cropland areas or beef cattle feedlots. In those studies, inflow was added to the top of experimental plots in four successive increments to simulate runoff rates occurring at greater downslope distances. Runoff rates on the sites where beef cattle manure or swine slurry was applied ranged from 2.20 to 22.9 L min-1, and maximum equivalent downslope distances varied from 22 to 108 m. The observations resulting from the field studies were first summarized. These observations resulted in the following question:

What are the mechanisms influencing nutrient transport in upland areas? Hypotheses were then developed to answer this question. Nutrient transport in upland areas was thought to occur under two scenarios. For scenario 1, the nutrient transport was influenced by: The quantity of P or N that was released by soil, manure, or slurry at a particular runoff rate and the amount of overland flow available to transport the released nutrients. For scenario 1, nutrient transport rates increased in a linear fashion with a runoff rate. Under scenario 2, the maximum rate at which soil or manure can release P to overland flow had been reached, and the P transport rate – runoff rate relation changed from a linear function to a constant value. Once the point of inflection occurred, P transport rates were constant. Predictions developed from the hypotheses and testing of those predictions will be identified in a subsequent oral presentation, "Prediction and Testing of Nutrient Transport Equations Developed for Upland Areas".

Prediction and Testing of Nutrient Transport Equations Developed for Upland Areas

Authors: *John E Gilley (USDA-ARS)**

A previous oral presentation described the "The Identification of Mechanisms Influencing Nutrient Transport on Upland Areas". The present exercise was performed to make predictions based on the previously formulated hypotheses and to then test the accuracy of the predictions. The slope of the linear equations relating phosphorus (P) transport rates to runoff rates was related to the P content of soil or manure when small amounts of manure were broadcast. Transport rates for P were estimated from measurements of runoff rates on sites where varying amounts of slurry had been applied. In addition, the maximum rate at which manure can release P to overland flow was determined from the P content of manure. Finally, transport rates for nitrogen (N) were related to runoff rates on sites containing varying amounts of soil N and locations where selected quantities of cattle manure or swine slurry had been applied. Additional experimental data is needed to determine if the maximum rate at which soil or slurry can release nutrients to overland flow can be related to the nutrient content of these constituents.

Utilizing Ag Retailer Data to Measure Conservation Practice Adoption by Iowa Farmers

Authors: *Ben Gleason (Iowa Nutrient Research & Education Council)**

In 2015, Senate File 494 established a pilot project to track progress on implementing the Iowa Nutrient Reduction Strategy. The Iowa Nutrient Research & Education Council (INREC) worked with Iowa State University to develop a first-of-its-kind data collection system using agricultural retailer sales data to track in-field nutrient application and conservation practices. The system has been used for a statistical extrapolation of statewide adoption of nutrient reduction practices since 2017.

Each year, 150 of approximately 600 total ag retail locations that offer nutrient sales and services are randomly selected and stratified across the 8 major land resource areas based on the percentage of row crops to ensure representative sampling across the state. INREC staff visit the locations to collect data from ten randomly selected fields for in-field nutrient reduction. INREC aggregates the data to ensure confidentiality, and the ISU Center of Survey Statistics Methodology extrapolates the data for statewide adoption.

The survey has been completed for five crop years (2017-2021). Below are some of the results.

- Commercial nitrogen application rates (Figure 1) for corn following soybeans increased from 2017 to 2020, with a decrease in 2021. Nitrogen rates for corn following corn were steady from 2017 to 2019, followed by an increase in 2020 and a decrease in 2021.

- Cover crop acres (Figure 2) increased from 1.6 million acres in 2017 to 3.1 million acres in 2020, with a decrease to 2.8 million acres in 2021. Rye is the most frequently used cover crop species, averaging 81% of cover crops over the five years.
- Nitrogen application timing varies with combinations of fall, spring pre-plant, and in-season. Fall-only applications averaged 17.9%.
- Variable rate applications of nitrogen and phosphorus were added to the survey in 2019, with nitrogen increasing from 8.7% in 2019 to 16.1% in 2021 and phosphorus increasing from 49.6% in 2019 to 57% in 2021.

Subject: Edge-of-Field Practices and Monitoring

Location: Room 314 on Main Level

Time: 10:30 AM - 12:00 PM

Can Long-Term Soil Health Reduce Edge-of-Field Water and Nutrient Losses?

Authors: *Vinayak Shedekar (Ohio State University)*; Chris McNabb (The Ohio State University); William Osterholz (USDA-ARS); Ryan Winston (The Ohio State University); Michael Brooker (Ohio State University); Nathan Stoltzfus (Ohio State University); Kevin King (USDA-ARS); Greg LaBarge (The Ohio State University); Margaret M. Kalcic (University of Wisconsin-Madison); Jay Martin (Ohio State University)*

This project explores the co-benefits of long-term soil health practices (SHPs) and their potential impacts on water quality. Long-term, continuous, and integrated SHPs (e.g., no-till+crop rotation+cover crops) build healthy soils and are important elements of sustainable agroecosystems. Few studies assess the effect of improved soil health on edge-of-field (EOF) water quality, i.e., nutrient and sediment loss. Those studies that have focused on both soil health and water quality have primarily considered the short-term effects of a single SHP. However, these studied systems are, in fact, “transitional”, and measurement likely ceases before the systems become “mature” and manifest their full potential. We will present the findings based on 2 years of water quality monitoring using paired-field studies at three different locations in Ohio, USA. Each field is instrumented with flow monitoring to continuously monitor surface runoff and subsurface drain discharge, and automated water samplers. Water samples are analyzed for concentrations of analyze total nitrogen (TN), nitrate (N), total phosphorus (TP), and dissolved reactive phosphorus (DRP). Preliminary findings suggest that compared to “No SH” long-term soil health systems... (1) Generate less volume of water discharge through both tile and surface pathways, (2) Had lower DRP and TP losses per acre, despite greater DRP and TP concentrations in surface runoff, and (3) Had lower concentrations and losses of Nitrate per acre. Long-term monitoring of these sites is crucial for conclusive evidence of the efficacy of soil health practices.

Edge-of-Field Water Quality Monitoring in Western Kentucky

Authors: *Brad Lee (University of Kentucky)*; Glynn Beck (University of Kentucky); Jason Unrine (University of Kentucky); Erin Haramoto (University of Kentucky); John Grove (University of Kentucky)*

To quantify the water quality benefits of best management practices (BMPs) in agricultural fields, the USDA-NRCS partnered with Kentucky landowners via the Environmental Quality Incentives Program (EQIP) to develop long-term, edge-of-field, water quality monitoring stations to collect surface water runoff and measure the sediment and nutrient loads that are lost from crop fields and wetlands. The University of Kentucky is the monitoring partner for nine landowners and measures nutrients and sediment in agricultural runoff across 29 edge-of-field water quality monitoring stations established according to USDA-NRCS EQIP Standard Practice 201 and 202. Because the USDA-NRCS EQIP 201 and 202 funding is insufficient for both BMP implementation and water quality monitoring, additional financial partners include the Kentucky Soybean Promotion Board and the Kentucky Agricultural Development Board. At present, we are evaluating the effectiveness of BMPs, including poultry litter incorporation, grassed waterways, cover crops, and conservation easements. The land management systems where these monitoring stations are located include no-till fields in corn-soybean, corn-soybean-wheat, and soybean-wheat rotations, as well as tree plantings of increasing age. Within each monitored watershed, runoff samples are collected after every runoff-generating precipitation event and analyzed for total solids, nitrate+nitrite, ammonia, orthophosphate, total Kjeldahl nitrogen, and total nitrogen

and phosphorus. The baseline, first cropping cycle of the agricultural runoff data collected at the monitoring stations will be discussed.

Engineering Lessons Learned for Edge-of-Field Blitz Projects

Authors: *Caleb D. Rasmussen (ISG)**

Unlike one-time edge-of-field (EOF) projects, a blitz involves multiple landowners participating in numerous water quality projects targeted over the course of many months. The process streamlines initial site investigation, design, and construction to accelerate the implementation of edge-of-field conservation practices. Building on lessons learned from the field, this presentation will specify best practices to ensure that the engineer you are working with has the right information at the right time. From communication touchpoints and surveys to accurate documentation, we will discuss ways to provide clear information to the full project team so that EOF blitz projects are designed accurately and constructed efficiently in the field.

Use of Archived Soil and Water Measurement from the Fort Cobb Reservoir Experimental Watershed (FCREW) to Mimic an Edge-of-Field Experiment for Monitoring of Natural Resources

Authors: *Ann Marie Fortuna (USDA-ARS)*; Patrick Starks (USDA-ARS); Daniel Moriasi (USDA-ARS); Jean L Steiner (KSU)*

One of the primary goals of the USDA Natural Resource Conservation Service (NRCS) practice programs is to protect and improve water quality. Land cover is often used to predict water quality indicators (WQI) but may limit land managers' abilities to predict the effects of previous management (fertilizer applications, disturbance, and shifts in plant populations). NRCS Practice Code 201, Edge-of-Field Water Quality Monitoring and Evaluation, provides a systematic approach to evaluate the effectiveness of conservation practices or systems in reducing erosion and loading of constituents to water resources. This approach enables us to fill an existing gap between soil health and watershed health. To strengthen this linkage, long-term field-scale experiments, and statistical methodologies must be designed and implemented to connect soil health indicators (SHI) with summary measures of water WQI. Our research objectives were to: 1) mimic an edge-of-field experiment using historical SHI and WQI, 2) use the results of nonparametric Spearman rank-order correlations to identify SHI and WQI that varied across the Fort Cobb Reservoir Experimental Watershed (FCREW) due to the effects of land use, management and inherent properties (soil texture, aspect, elevation, slope) on WQI, and 3) utilize the statistical outcomes to assess the sustainability of conservation systems on WQI. Correlation coefficient matrices verified statistically significant relationships between WQI and SHI across the FCREW. Adoption of conservation practices within the FCREW improved WQ such that water samples met the Environmental Protection Agency (EPA) drinking water standards. Future research should integrate current WQI sampling sites into an edge-of-field design representing all management by soil series combinations within the FCREW. USDA is an equal opportunity provider and employer.

Subject: Outreach, Education, and Community Engagement

Location: Room 315 on Main Level

Time: 10:30 AM - 12:00 PM

Building a Conservation Community: The Great Lakes Sediment and Nutrient Reduction Program

Authors: *Connor E. Roessler (Great Lakes Commission)*; Nicole Zacharda (Great Lakes Commission)*

This presentation will feature a brief history of the Great Lakes Sediment and Nutrient Reduction Program (GLSNRP) and lessons learned from recent efforts to build community among program participants. Landowners, conservation professionals, local or state government employees, and grant managers will gain an understanding of the process and benefits of these outreach efforts.

For more than 30 years, the GLSNRP has provided grants to local and state units of government and nonprofit organizations to install erosion and sediment control practices in the Great Lakes basin. Since 2010, funding for the program has been provided by the Great Lakes Restoration Initiative, allowing the program to fund innovative and unique projects. The GLSNRP is a state and federal partnership managed by the Great Lakes Commission (GLC) in cooperation with the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS), the U.S. EPA, and the eight Great Lakes states.

With project types spanning streambank stabilization, agricultural management, and stormwater runoff mitigation, there exists a large pool of grantees with a wealth of experiences across the Great Lakes basin. In addition to supporting individual grantees, staff at the GLC are connecting grantees to share their experiences and challenges to improve the environmental and educational outputs of the grant.

Grantees are asked to conduct outreach campaigns to inform appropriate audiences of their projects to reduce sediment and nutrients. Additionally, grantees have the opportunity to join a moderated listserv to share examples and events of interest related to water quality and soil health for the region. The GLC also hosts a biennial gathering, the GLSNRP Dialogues, centered on sharing challenges, setting program priorities, and learning from successful projects.

Enhancing Conservation Adoption Using Agronomic Principles

Authors: *Benjamin Porepp (Iowa Soybean Association)*; Rosie Roberts (Iowa Soybean Association); Ryan Johnson (Iowa Soybean Association); Evan Brehm (Iowa Soybean Association); Joe Wuebker (Iowa Soybean Association)*

There has never been a more opportunistic time for farmers to adopt conservation practices. The number of cost share and incentive programs is growing by the year. But why is reaching the next wave of adopters so challenging? Is it because we focus too much on incentives and financial subsidies? Is it a lack of confidence in sustainable implementation? A fear of loss in ROI? This presentation will evaluate the agronomic principles of conservation and detail how the ISA Conservation Agronomist Team is leveraging those principles to enhance the adoption of conservation practices across Iowa. The speakers will outline the agronomic benefits, challenges, and science behind how conservation practices impact the farmer in relation to ROI, farm efficacy, efficiency, and sustainability.

The presentation will begin with a brief introduction to the Conservation Agronomist Team and an overview of our roles in promoting conservation across Iowa. The presentation will profile how ISA Conservation Agronomists leverage agronomic principles, along with financial and technical planning/assistance, to enhance

and drive conservation adoption. The attendees of this presentation will better understand how conservation affects both ROI and all other aspects of a farming operation and will be armed with a new approach to reaching the all-important next wave of conservation adopters by utilizing agronomic principles.

Improving Conservation Delivery by USDA

Authors: *Alex Echols (The Keith Campbell Foundation for the Environment)**

The Keith Campbell Foundation for the Environment commissioned an independent assessment of how to improve conservation delivery by the Department of Agriculture. This assessment provides specific recommendations for strengthening both Financial Assistance and Technical assistance by the Natural Resources Conservation Service. Included in the recommendations are strategies to shorten the time for delivery of conservation, reduce the administrative burden and broaden engagement in conservation particularly with the increased funding made available in the Inflation Reduction Act. The agency will be severely challenged to deliver the new funding levels without expanding internal capacity as well as broader engagement of the private sector through increased use of Technical Service Providers and other mechanisms. In addition, the assessment recommends streamlining financing to move to larger scale actions. Specifics on the assessment as well as Farm Bill updates will be provided in this session.

Land Use Concerns and the Adoption of Utility-Scale Solar in Local Communities

Authors: *Jian Chen (Iowa State University)*; Hongli Feng*

Utility-scale solar photovoltaic (PV) energy is regarded as a fast approach for transitioning the United States towards a decarbonized power grid and a clean energy future. However, it may also raise concerns about the local impacts of utility-scale solar, such as land-use conflicts with agricultural production. For example, Iowa lawmakers proposed the Senate Study Bill 1077 to prohibit the construction of utility-scale solar panels on land suitable for farming, which would limit options for landowners and hinder the growth of solar power (McCullough, 2023).

Existing studies have shown that local communities play a critical role in utility-scale solar development. However, studies concerning the trade-offs between local economic, environmental, and agricultural land-use impacts of utility-scale solar projects were still limited in the existing literature. This study aims to examine the attributes of utility-scale solar PV projects that drive the adoption in local communities and the tradeoffs with agricultural land use. The findings will improve the understanding of utility-scale solar deployment in local communities and help design more informed policies for future solar development.

First, we will present a comprehensive review of the existing literature, policies, and local zoning practices related to the deployment of utility-scale solar. Second, we will provide a system of metrics that will facilitate the comparison of utility-scale solar PV projects and weigh the tradeoffs of land use and other factors, including the life-cycle carbon emissions reduction, lease payment to landowners, and savings in energy cost. Lastly, we will support the first two aspects described above with an economic study that quantitatively weighs the tradeoffs. The empirical analysis will be based on data collected through a Discrete Choice Experiment and will focus on local administrators in the states of Iowa, Minnesota, Illinois, Wisconsin, Indiana, Ohio, and Michigan.

Subject: Soil Health Resources, Indicators, Assessment, and Management

Location: Room 316 on Main Level

Time: 10:30 AM - 12:00 PM

Factoring Soil Health into Land Valuation: An Economic Driver for Resilient Agriculture

Authors: *Joshua Zuckerman (Delta Institute)**

Improving soil health is critical on farms, yet there are few economic incentives that encourage adoption. Delta Institute has partnered with Compeer Financial and the Soil Health Institute to address this issue by factoring soil health into the land valuation process in Michigan and Illinois. This work is sponsored by the Walton Family Foundation, Erb Family Foundation, and the Lumpkin Family Foundation. This work is necessary to help transition farms to soil health management practices.

Delta Institute (Delta) has engaged stakeholders, evaluated existing land valuation systems, and created interventions in both Michigan and Illinois. Delta will conduct appraisals that collect land management history data and soil health data. The data will be utilized to factor soil health into land value.

Delta's work is expected to provide an economic driver for farmers. The outcomes will shed light on the relationship between soil health and land value, incentivizing and informing decision-making for resilient agriculture practices and business planning.

Delta's outcomes will advance the understanding of soil health for farmers and appraisers, contributing to a more accurate land valuation process. This work benefits both the scientific community and society by advancing the adoption of soil health testing on farms and the environmental benefits of improved soil.

The next steps include piloting interventions in Michigan and Illinois and scaling up the approach. Delta's goal is to create an economic driver that incentivizes farmers to adopt practices that improve soil health.

This session is relevant for professionals in agriculture and real estate, as well as policymakers interested in increasing the adoption of soil health management practices. The session will provide a chance to learn about the Delta's work, engage in discussions on soil health land valuation, and share perspectives and experiences related to sustainable land use practices.

Soil Decompaction and Compost Amendments Improve Infiltration Rates and Soil Health in Urban Development

Authors: *Grant L. Thompson (Genus Landscape Architects)*; Marshall McDaniel (Iowa State University); Pat A. Sauer (ISWEP)*

Urban land use – characterized by intense soil disturbance for site development – is rapidly expanding. Construction disturbance and any mitigating management practices can have long-lasting effects on soil ecosystem service performance (e.g., water infiltration, soil health, plant growth, and carbon sequestration). This study is a multi-institution collaboration, including the Northgate Development Company, the Iowa Stormwater Education Partnership, and researchers from Iowa State University and Genus Landscape Architects. A multi-season residential scale field test was conducted to evaluate different soil quality restoration (SQR) practices on stormwater infiltration and soil health following a phased site grading approach typical for suburban residential development. We tested the impact of five SQR practices, including a) a business-as-usual treatment with compacted subsoil and 10 cm loosened topsoil (Control), b) mechanically decompacted subsoil

and 10 cm loosened topsoil (MD10), c) biologically decompacted subsoil (with tillage radish) and 10 cm loosened topsoil (BD10), d) mechanically decompacted subsoil with 5 cm of loosened topsoil mixed with 5 cm compost (CST5), and e) mechanically decompacted subsoil mixed with 5 cm compost and 10 cm loosened topsoil (CS15). After turfgrass was established in all plots per typical practice for erosion control, we measured soil bulk density (and other physical parameters), infiltration rate, microbial biomass, and microbial activity assessed via decomposition. We found variable but improved infiltration with decompaction and compost amendment, increased organic matter content with soil amendments, and increased microbial biomass C and N with organic amendments. We also demonstrate the use of tea bags as a useful low-expense and low-tech means of assessing soil biological health.

Soil Health Management Indices for Cropping Systems of North America

Authors: *Adebukola Dada (Soil Health Institute)*; Michael Cope (Soil Health Institute); Jason Ackerson (Soil Health Institute); Cristine L.S. Morgan (Soil Health Institute); Wayne Honeycutt (Soil Health Institute)*

Improved communication and scientific evaluation of soil health management practices, cropping systems, and climates require a standard and preferably numerical expression. Specifically, the development of simple calculations from recorded management data to evaluate management effect on soil health expression could streamline communication with on-farm and off-farm stakeholders about practice adoption (specifically the presence of additionality). Our objectives were to develop simple soil health management indices that are practical and effective for assessing management impact on soil health indicators and identify a minimum set of management information to generate these indices. This paper describes the method used to derive three numerical soil health management indices and the evaluation of their relationship to the fundamental principles of soil health management. Management and soil health data, collected as part of the North American Project to Evaluate Soil Health Measurements, were used to calculate and evaluate these indices. The generalized tillage intensity rating (gTIR) and live root index (LRI) are presented as numerical, random, and continuous variables representing a gradient of adoption of soil health management practices. The study showed that gTIR and LRI have significant responses to changes in soil organic carbon concentration, aggregate stability, and carbon mineralization potential. Both indices proved effective for identifying changes in soil health indicators and scalable continentally through practicality in data needs for row crop production systems across North America. They are appropriate for farmer-facing evaluations, project, or survey-based assessments in populations of interest, and for documentation of agronomic management in scientific reporting of soil health studies.

Soil Health Responses to Tillage, Manure, and Cropping Practices in Ohio

Authors: *William Osterholz (USDA-ARS)**

Improving soil health is an important goal of several cropland management practices, such as reduced tillage intensity, manure application, crop rotation, and cover crops. However, the effectiveness of these practices beyond plot-scale research remains uncertain. This research assessed how 5 years of management practices influenced soil health indicators across 40+ fields in Ohio. Indicators of soil health included soil organic carbon, soil respiration, aggregate stability, active C, and soil protein. Results are currently in progress and are expected to reveal the effects of management practices on the soil health indicators. Insights from this work will advance understanding of the range of soil health responses to management in Ohio, in turn helping farmers prioritize management practices that are most likely to improve soil health.

Subject: Water Resource Assessment and Management

Location: Room 317 on Main Level

Time: 10:30 AM - 12:00 PM

Evaluation of Edge-of-Field Sulfate Runoff Losses at Eight Arkansas Discovery Farms

Authors: *James M. Burke (University of Arkansas)*; Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service)*

Management of land-applied and legacy-soil nutrients is a vital component of effective agricultural production. Land-applied nutrient removal through surface runoff presents obstacles to sectors of Arkansas agriculture. Although the preponderance of investigations concerning nutrient runoff loss has primarily involved nitrogen (N) and phosphorus (P), runoff losses of secondary nutrients such as sulfur (as sulfate, SO_4^{2-}) are not as extensively examined. In May 2022, the Arkansas Discovery Farms Program (ADF) initiated research evaluating the concentrations and land area losses of sulfate-sulfur (SO_4-S) accumulated in edge-of-field runoff samples from 8 ADF locations. These ADF sites encompass row crops, forage, as well as livestock and poultry operations. Statistical analysis of initial data assessing edge-of-field runoff samples by ADF location revealed that the row crop operations in Light and Dumas, Arkansas, respectively, had significantly greater SO_4-S concentrations in edge-of-field runoff compared to the rest of the ADF sites. Statistical analysis of SO_4-S losses by land area showed that Newport, Dumas, Light, and Elkins had significantly higher losses when compared with the rest of the ADF locations. The residual ADF sites fluctuated in their own significant differences also, emphasizing the effect of how methodologies concerning crop and nutrient management can differ between farms. Statistical analysis of total runoff per acre indicated Newport was significantly greater than the remaining ADF locales. The subsequent incorporation of non-growing season edge-of-field runoff data, data compiled from periodic soil sampling, and assessments of land-applied SO_4-S fertilizer productivity will generate a concise understanding of SO_4-S runoff characteristics along with its ensuing behavior within the soil influenced by different agricultural production systems.

Hydrological Modeling of a Wetland Complex in Hamilton County, Iowa, Using HydroGeoSphere

Authors: *Jorge Alejandro Gomez Martinez (Iowa State University)*; Antonio Arenas (Iowa State University); Keith Schilling (Iowa Geological Survey)*

Using HydroGeoSphere (HGS), a hydrologic model was developed to investigate the connectivity between the surface ponding and the water table in a Pothole complex in Iowa's prairie pothole region. HGS is a coupled hydrologic model that uses Saint Venant equations and Richard’s equation to calculate the surface water and the groundwater flow, respectively. The pothole complex is located in Hamilton County; it contains three potholes and is being drained by a tile drainage network. The model was run for 12 years (2010-2021) and calibrated using water table measurements in one of the potholes, and surface ponding from aerial photos. Since there is no documentation of the actual tile drainage network, a new network had to be designed in order to evaluate the drain’s impact on the model. A mesh sensitivity analysis was conducted to optimize the discretization of the mesh. This research is still undergoing; however, the results will evaluate the effectiveness of the tile drainage network and its effect on the connectivity between the ponded surface water and the water table.

Integrated Surface-Subsurface Modeling of a Low-Head Dam to Enhance Aquifer Recharge

Authors: *Antonio Arenas (Iowa State University); Betret S. Eustace (Iowa State University)**

Prolonged drought conditions can stress water systems, affect power generation and agriculture, and disrupt commerce and economic activities. As it is the case with other weather-related disasters, droughts disproportionately impact vulnerable populations, and underserved communities often don't have the resources or alternatives to adapt to drought conditions exacerbated by climate change. Denison is a city with 8,000 residents in Crawford County in Western Iowa, a county that is most reliant on agriculture and the most socially vulnerable in the state. In recent years, prolonged dry conditions in Western Iowa have impacted water levels in the unconfined aquifer that Denison uses as a drinking water source, and city officials are looking for alternative ways to guarantee Denison's water supply for years to come. This study presents a feasibility study on the construction of a low-head dam on the Boyer River near Denison as a way to augment the groundwater supply. The main objective is to quantitatively assess the increase in aquifer levels derived from the construction of the low-head dam. Analyses were made using novel physics-based surface-subsurface modeling under historic and future climatic conditions projected by the CMIP6 climate models. The research is still undergoing, and the results will provide 1) technical considerations of a low-head dam as a way to raise aquifer levels and 2) recommendations for water planners and stakeholders to prepare for anticipated future drought conditions.

Wetland Siting and Implementation: Successes, Challenges, and Lessons Learned

Authors: *Spencer Pech (ISG)*; Shane A. Wulf (Iowa Department of Agriculture and Land Stewardship)*

Water-quality wetlands are proven effective for reducing nitrogen loss from cropland, making the practice a vital component in advancing the Iowa Nutrient Reduction Strategy. The Iowa Department of Agriculture and Land Stewardship (IDALS) partnered with the Soil and Water Conservation Society to develop wetland process models that help landowners and conservation professionals understand each step along the project path to implement a wetland project. This presentation will walk through the process of identifying a site suitable for wetland restoration and the cooperative relationship between multiple agencies, engineering consultants, and landowners to achieve water quality goals. Recent case studies will demonstrate methods for completing drainage district projects that integrate wetland components and the challenges, both anticipated and unanticipated, that must be worked through to understand the true potential of expanding wetlands on the landscape.

Subject: Conservation Economics and Policy

Location: Room 314 on Main Level

Time: 1:30 PM - 3:00 PM

A Farmer's Guide to Soil Health Economics

Authors: *Ben Wiercinski (American Farmland Trust)*; Michelle Perez (American Farmland Trust); Ellen Yeatman (American Farmland Trust)*

Farmers are increasingly asked to rethink how they are farming in order to reduce their impacts on waterways and address the challenges posed by climate change. This often requires them to adopt new conservation practices that bring both costs and benefits to producers. How these practice changes affect a producer's bottom line may have a large impact on their decision to adopt. Though there is an increasing amount of evidence on the benefits and costs of soil health practices to farmers, the information is often not written for a farmer audience or is scattered in different places across the internet. American Farmland Trust, through funding from NRCS, is creating a farmer's guide to soil health economics, which reviews the current economic literature but is written as an extension piece for producers and on-the-ground conservationists. The guide walks through the costs and benefits of different soil health practices while explaining the different methodologies, such as farmer surveys, research or on-farm demonstration trials, or individual farmer case studies, and their pros and cons.

Through reading the guide, farmers will be better able to understand the potential outcome of their decision to adopt soil health practices, hopefully leading to more informed choices. By weaving together various threads from the literature on soil health economics, we are able to highlight farmers' crucial results from across the different types of literature, such as survey results highlighting that farmers are adopting practices largely without cost share or detailed case studies finding how farmers successfully overcome the increased costs of cover crops. This work, starting with soil health practices on row crop operations, will lead to more farmer guides for additional production systems in the future. The goal is to produce materials that quickly inform the reader and guide them to where to look for more in-depth information.

Economics of Soil Health Systems across Thirty U.S. Farms

Authors: *Emily Bruner (Soil Health Institute)*; Jessica Kelton (Soil Health Institute)*

Improving soil health can help farmers build drought resilience, increase nutrient availability, suppress diseases, reduce erosion, and reduce nutrient losses. Soil health management system implementation also benefits the environment by storing soil carbon, reducing greenhouse gas emissions, and improving water quality. However, investing in soil health management systems (SHMS) is also a business decision. The Soil Health Institute (SHI) partnered with the National Association of Conservation Districts (NACD) to assess, demonstrate, and communicate the economics of soil health-promoting practices to increase the adoption of soil health management systems and achieve on-farm and environmental benefits. Extensive interviews were conducted with 30 farmers implementing SHMS to learn about their experiences with adopting those systems and to assess the impact of that adoption on net farm income. Results from SHI's partial budget analysis include an average increase in net farm income of $65/acre across 29 operations interviewed. The wide range of farms, production systems, and climates represented in this project supports the growing body of evidence that SHMS implementation can provide significant returns on investment, indicating that many more farmers may also benefit economically from SHMS adoption. Session attendees will be introduced to a wide array of project

resources, including 30 economic fact sheets and videos for use in their own soil health training, education, and outreach programs to help expand SHMS implementation and provide land managers with the information they need to successfully adopt management changes that benefit their bottom line, the environment, and society.

Using Economics and Sequential Diagnostic Monitoring to Rapidly Meet Water Quality Goals

Authors: *Mike Kinney (Comfort Lake Forest Lake Watershed District)**

Mike Kinney is the District Administrator for the Comfort Lake-Forest Lake Watershed District, a special unit of local government based in Forest Lake, Minnesota. Mike will present the District's unique approach to identifying cost-effective water quality improvement projects to restore impaired lakes and protect unimpaired lakes. The District's emphasis on cost-benefit is relevant in the world of watershed management, given increasing material costs, limited funding, and high public demand for improved water quality.

Using a combination of sequential diagnostic monitoring, modeling, historical aerial photography, and local knowledge of past land management activities, this approach focuses on both historical legacy nutrient loads in addition to real-time sources. Most watershed management entities rely heavily on computer modeling alone. The District has followed the Pareto Principle, or 80/20 rule, and has identified a small number of projects that have addressed 93% of the pollutants loading to lakes.

As a result of the efforts described above, the District has achieved this 93% reduction needed to meet state water quality goals within just a 10-year timeframe. Partnering with local communities like the City of Forest Lake, the District has implemented projects resulting in the annual removal of over 3,700 pounds of phosphorus, the creation of 65 ac-ft of floodplain storage, the restoration of 185 acres of wetlands, and the preservation of 77 acres of natural upland.

The target audience for this session is watershed managers with limited staff and financial resources. The presentation will include two approaches to obtaining the necessary level of data to identify a small number of targeted projects that will have the greatest impact on improving water quality.

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Location: Room 315 on Main Level

Time: 1:30 PM - 3:00 PM

Combining Decision Support Tools for a New Era of Conservation Planning

Authors: *Haleigh Summers (Iowa State University)*; Emily K. Zimmerman (Iowa State University); John Tyndall (Iowa State University); David James (USDA-ARS National Laboratory for Agriculture and the Environment)*

Conservation practice implementation in the US Corn Belt is the primary mechanism to reduce nonpoint source nitrogen and phosphorus pollution to surface waters and meet broader water quality goals. A new era of conservation planning and capacity – fueled by high-resolution data, sophisticated planning decision support tools, and advancements in simulation models – is increasing the efficacy and efficiency of conservation professionals to plan and operationalize conservation across scales. This study examined how these new data and tools can be deployed to inform where conservation practices presently exist, where opportunities are for new practice placement, and previous and future outcomes (i.e., costs and nitrate reduction) associated with conservation practices. To do this, we used and adapted new tools, including the Iowa Best Management Practice (BMP) Mapping Project, the Agricultural Conservation Planning Framework (ACPF), and the ACPF Financial and Nutrient Reduction Tool (ACPF FiNRT), in three case study watersheds. In this study, we demonstrated how available data and tools can facilitate an understanding of previous conservation efforts and guide future resource investment to meet nitrate reduction goals.

ISAP's Conservation Story Map: Using Interactive, Place-Based Storytelling to Support Farmers and Communicate State-Wide Conservation Efforts

Authors: *Helen VanBeck (American Farmland Trust)*; Jean Brokish (American Farmland Trust)*

The Illinois Sustainable Ag Partnership (ISAP) brings together 15 member organizations working collaboratively to encourage the adoption of sustainable and profitable agricultural practices that improve soil health and restore local waters. ISAP's impact is strengthened by developing research-backed, comprehensive programming, building a strong network of ag professionals well-versed in conservation principles, and sharing the stories of conservation leaders across the state. ISAP recently launched an interactive Conservation Story Map to showcase sustainable agriculture efforts in Illinois and facilitate connections among leaders in soil health and nutrient loss reduction. ISAP's Conservation Story Map features farmers, service providers, conservation specialists, research, and demonstration sites across the state of Illinois that are successfully adopting, exploring, or promoting conservation cropping systems and conservation drainage management. The Story Map communicates the system-wide approach that is necessary to achieve the state's nutrient loss reduction goals, acknowledging that every farmer's soil health and water quality journey may look a little different. In addition to demonstrating how the Conservation Story Map can help connect Illinois farmers to local conservation resources, we will share the process we took to develop the Story Map, our approach to sharing farmer stories, and how other organizations could replicate this tool to tell their own conservation stories and better connect conservation efforts in their states.

Using a Cooperative Research Network to Define Dynamic Soil Property and Soil Health Reference Conditions for Soil Survey

Authors: *Skye Wills (USDA-NRCS)*; Tiffany Carter (USDA-NRCS); Ekundayo Adeleke (USDA-NRCS-NSSC)*

National cooperative soil survey (NCSS) products are often used in land management planning to provide information related to inherent soil properties. The use of dynamic soil properties (DSPs) and soil health indicators for soil surveys requires that reference and benchmark values be established for various soil types. To address this need, the Soil and Plant Science Division (NRCS-SPSD) coordinated a series of projects known collectively as Dynamic Soil Properties for Soil Health (#DSP4SH). The goals of these projects focus on establishing consistent data collection, aggregation, and presentation protocols for DSPs and soil health metrics that can be used for conservation assessment, soil test interpretation, and as a part of soil survey. These projects combine concepts from ecological sites and state and transition models to establish reference values that can be expanded and extrapolated. General agronomic concepts are also applied to business as usual and soil health management systems so that typical and aspirational values can be established by the project, management system, and soil series through DSP4SH projects. The data from these projects are publicly available for use by researchers and practitioners. A tool that allows easy exploration of the data will be presented.

Utilizing Traditional Ecological Knowledge to Guide the Development of a USDA-NRCS Interim Conservation Practice on Soil Health

Authors: *Joe Williams (USDA-NRCS); Michael Margo (USDA-NRCS)**

A multidisciplinary team of subject matter experts from USDA Natural Resources Conservation is drafting an Interim Conservation Practice Standard addressing soil organism habitat loss and aggregate instability by incorporating traditional ecological knowledge (TEK) on various land uses. Potential management considerations include 1) Using plants, including rotations and simultaneous plantings, to include perennial, biennial, and annual management schemes of plants; 2) Using livestock and management of livestock; 3) Using low-intensity burns in a restorative capacity to stimulate soil organism activity that is unique to low-intensity fire or fire-dependent; and 4) Using management methods that will feed, recharge, and encourage connections and communications among plants and soil organism species. Within the NRCS Soil Health Division, the Indigenous Practices Team is overseeing the development of the interim standard. Other activities related to soil health technical outreach by the Indigenous Practices Team will be presented.

Subject: Social Sciences Informing Conservation

Location: Room 316 on Main Level

Time: 1:30 PM - 3:00 PM

Agricultural Ecosystem Service Marketplaces: Farmer Perspectives on Program Efficacy and Soil Health Management

Authors: *Sara Kelemen (USDA Northeast Climate Hub)*; Rachel Schattman (University of Maine)*

Payment for ecosystem services (PES) programs, especially payment for soil carbon programs, are proliferating rapidly in the United States. These programs pay farmers for measurable positive environmental change, which not only improves on-farm soil health outcomes but also benefits downstream communities and the general public. However, these programs can only be successful in achieving conservation goals if farmers and land managers are interested in participating. Therefore, it is necessary to understand farmer and land manager interest in engaging with these programs. We conducted interviews (n = 23) and a survey (n = 470) of Kansas wheat growers to assess farmer perspectives on, and interest in, outcomes-based PES programs, specifically those targeted at improving soil carbon and water quality. We found that farmers are interested in these programs but desire more information. Farmers expressed a preference for payment for environmental outcomes, rather than payment for practices. Additionally, they were divided in their desire to see either private or public control over PES programs. The availability of ecosystem service payments increased interest in soil health practices for farmers interested in and intending to implement soil health practices. However, generation of payments was not found to be a primary motivator for farmers to adopt soil health practices for farmers using, interested in, or intending to implement soil health practices. Instead, farmers were more motivated to adopt soil health practices by the potential for improved profitability, soil health, and land stewardship. As PES program administrators seek to increase farmer participation, outreach and messaging should an explicitly focus on soil health and profitability. Further research should focus on whether farmers who enroll in PES programs maintain use of conservation practices throughout their contract, and the role these programs have on enhancing conservation thinking.

Cultivating Farmer Leadership and Farmer-to-Farmer Learning Through Innovative Data-Driven Communication

Authors: *Anne Nardi (University of Wisconsin)*; Jenny Seifert (University of Wisconsin-Madison Division of Extension); Cara Urban (Trust in Food and Farm Journal)*

Conservation professionals have long sought to improve their communication with farmer leaders and increase participation in farmer-led conservation groups. Most often, farmer engagement occurs through relationship-driven, one-on-one outreach. While this technique is critical for practice adoption, it is often time-intensive and limited by staff capacity. In a new project funded by the US EPA, the University of Wisconsin-Madison Extension, Purdue Extension, and the Arkansas Cooperative Extension Service have teamed up with Trust in Food – Farm Journal's sustainable agriculture initiative – to augment traditional farmer engagement tactics with replicable, data-driven methods to increase the effectiveness of farmer outreach. The project team established key social-science-based indicators for farmer leaders and farmer-led conservation group participants, and Trust in Food has translated those indicators into predictive data-driven segmentation modeling. Using audience insights and strategic communication best practices, the team is creating a communication campaign targeted at recruiting potential farmer leaders and farmer-led conservation group participants. The team will deploy these campaigns in pilot watersheds, in combination with more traditional relationship-driven engagement strategies, to raise

farmer awareness of (and interest in) a forthcoming farmer leadership program and conservation-focused field days. This presentation will invite conservation professionals who work with farmers and farmer-led conservation groups to learn about the novel social science-based communication tactics we are using, provide a sneak peek of the creative materials we've developed, and outline how we predict the campaign will improve farmer participation. Attendees will learn about cutting-edge communication methodology and be challenged to think creatively about a key component of our work – communicating effectively with farmers.

Differing Approaches to Farmer Outreach between Conservation Agencies

Authors: *Adam P. Reimer (National Wildlife Federation)*; Aleta Dam (National Wildlife Federation); Jessica Espenshade (National Wildlife Federation)*

The traditional conservation delivery system—collaborative programming and coordination between national, state, and local conservation agencies—has been an effective means of providing technical and financial support to farmers and ranchers for decades. Meeting the challenges of global climate change, increased demand for food and fuel, and the biodiversity crisis will require more producers to adopt regenerative farming systems. Reaching those producers who have not yet adopted practices requires innovative approaches to engagement strategies. National Wildlife Federation's (NWF) Grow More outreach training program seeks to equip conservation professionals with communication skills to engage new producers. Professionals from multiple agencies, including the Natural Resources Conservation Service, local soil and water conservation districts, Cooperative Extension, and non-governmental organizations, have participated in this program since 2019. This presentation uses program evaluation survey data to highlight differences in engagement and messaging approaches used by these different organizations. Local conservation district and extension personnel utilize a broader array of messaging strategies, gain more knowledge and confidence from learning about communication principles, and engage in more direct outreach with farmers compared with NRCS staff, who gain most from behavior change and social science concepts. These differences reveal the varying roles these organizations play in the conservation delivery system and the programming they deliver. This presentation will also provide insight into training needs for conservation professionals to effectively engage a diverse array of farmers and ranchers.

How a Website for Farmer-to-Farmer Learning about Conservation Practices Applies the Science of Behavior Change

Authors: *Jenny Seifert (University of Wisconsin-Madison Division of Extension)**

Making changes to a farming operation often involves a level of risk that can make many farmers uneasy, even if it would mean long-term gains for their soil, land, and bottom line. When grappling with risk, sometimes the most helpful thing is hearing from another farmer who has been there and done that. This is one of the reasons why farmer-to-farmer learning is on the rise as a strategy to increase voluntary adoption of conservation practices. But farmer-to-farmer learning doesn't always have to happen at field days or in coffee shops. One Good Idea (goodideafarm.org) is an online clearinghouse of videos and podcasts that feature farmers sharing their first-hand experiences with conservation practices. Its purpose is to facilitate "on-demand" farmer-to-farmer learning to help farmers discover ideas that can help them take the next step on their conservation journey. The multi-state team of university Extension professionals and farmers that created One Good Idea was intentional about applying the science of behavior change in the design and strategy of the platform. Targeting the "moveable middle" of farmers, the platform integrates theories such as Diffusion of Innovations and Theory

of Planned Behavior, delivering practical information and leveraging social norms, for example, to help nudge users to try something new. This presentation will be an overview of One Good Idea, the science behind it, and how it could support the goals and programming of conservation professionals who engage with farmers. We will also share what we're learning from it about farmer engagement, such as what sort of video seems to get more traction (spoiler alert: authenticity matters but fancy cameras don't) and potential barriers to getting a farmer in front of the camera. We will also share the results of user evaluations we are undertaking this spring and summer to understand the site's impact on user perceptions, intentions, and behaviors.

Subject: Soil Health Resources, Indicators, Assessment, and Management

Location: Room 317 on Main Level

Time: 1:30 PM - 3:00 PM

Correlations between Management Practices and Aggregate Stability in Central Kansas

Authors: *Adam Petty (Kansas State University)*; DeAnn Presley (Kansas State University); Peter Tomlinson (Kansas State University)*

Assessing aggregate stability under various management practices can help to understand which practices are likely improving soil structure and which are degrading it. Aggregate stability can play a role in plant growth through access to water and nutrients, soil carbon storage, and environmental quality. Between August and December 2022, 100 pedons were sampled from producers' fields within Harvey and McPherson counties, with 12 years of management history for every location. Aggregate stability analyses were run on each pedon at 0-5cm, 5-10cm, and genetic horizon thereafter to a depth of 100cm. Three methods compared are the multi-sieve machine method of Mikha and Rice (2004), the Kellogg Soil Survey Laboratory single-sieve method, and a smartphone-application method called SLAKES. The objectives were to evaluate any correlations between management practices and aggregate stability, especially within the top three depths of each pedon, as well as to compare results given by the different methods of analysis. The major categories of management were perennial/native vegetation, no-till, and tillage-intensive systems. Results varied significantly, showing less stability generally at lower depths. Also noted was that management practice influence was dependent on how long that practice had been in place. Cropping rotation, or lack thereof, also played a key role in aggregate stability in the upper 3 depths. The SLAKES method scored closely with the Mikha and Rice method, with less consistency coming from the KSSL single-sieve method. The systems with the least disturbance and the most varied plant species throughout the 12-year period showed more stable aggregates consistently over intensively tilled fields with fewer crops in rotation. This information can be used to determine what management practices will be preferred in this area to enhance soil aggregate stability.

How Management Impacts the Functionality of Surface Aggregates and Resilience to Rainfall Intensification

Authors: *Ken Wacha (USDA)*; Thanos Papanicolaou (USDA-ARS); Jerry L. Hatfield (Retired)*

In agricultural systems, the soil active layer (top 5cm) is by far the most dynamic in response to landscape processes and management practices. Surface aggregate characteristics, namely the distribution and stability of surface aggregate size fractions, regulate the movement of air, water, and nutrients through the column. During rainfall, unstable (weak) soil aggregates may rupture under water stress, releasing fines that can clog pore spaces, which can dampen infiltration and prompt ponding and runoff to occur. The surface aggregate characteristics within the active layer can serve as a proxy for management changes and hydrological connectivity of the landscape. In this study, we monitor changes in surface aggregates over six years during conversion from a conventional long-term corn-soybean system to a no-till w/annual rye cover crop. Surface soil samples (0-5cm) were collected annually along a 50m x 50m grid, to determine the distribution (mean weight diameter; MWD), stability (water-stable aggregates; WSA), and nutrient composition of aggregate size fractions, and biological activity (microbial biomass carbon; MBC). After just one year of conversion, field averages of MWD and WSA increased by 20% and 5%, respectively. Over the six-year study, there was a 45% increase in MBC, which indicates enhanced biological activity and aggregation. This testing framework provides quantitative metrics to evaluate the effectiveness of conservation practices and can aid in improving aggregation and transport models.

Long-Term Soil Erosion Effects on Plant Available Water Capacity

Authors: *Stephen Anderson (University of Missouri)*; Clark Gantzer (University of Missouri); Tim Rienbott (UMC South Farm Research Center)*

Plant available water capacity (PAW) is one of the most important soil properties to indicate the health of soil for potential plant productivity. Since grain crops in rainfed systems are so dependent upon water, stored soil profile water is essential for production. Soil erosion can substantially reduce the soil's profile available water capacity, especially for soils that have reduced water storage capacity in lower soil horizons. This study focuses on long-term soil management effects on soil erosion and subsequent reduction in plant available water capacity. The historic Sanborn Field provides an excellent field laboratory to study the effects of long-term soil erosion on available water capacity. Soils in Sanborn Field are predominantly Mexico silt loam (fine, smectitic, mesic Vertic Epiaqualfs) which has an argillic subsoil horizon often referred to as a claypan. The depth to claypan can be measured and illustrates the degree of long-term soil loss having occurred due to differences in crop management. Data on measured and estimated plant available water capacity values from historical plots of Sanborn Field were evaluated. Results illustrate the significant changes in these profile values due in large part to soil erosion that has occurred from some cropping systems. The study results show the importance of long-term conservation of soil for maintaining improved soil water storage for sustainable plant production.

Subject: Adaptive Management of Conservation Efforts

Location: Room 313 on Main Level

Time: 3:30 PM - 5:00 PM

Assessing Fertility Needs, Associated Crop Yields, and Environmental Benefits of Intermediate Wheatgrass in Eastern Nebraska

Authors: *Roberta Bianchin Rebesquini (University of Nebraska-Lincoln)*; Andrea Basche (Department of Agronomy and Horticulture - University of Nebraska-Lincoln)*

The intensive management associated with many annual crops, including corn and soybean, includes annual tillage as well as frequent fertilization, and pesticide applications, which contribute to environmental degradation concerns such as water pollution and soil erosion. Intermediate wheatgrass (Thinopyrum intermedium), recognized under the trade name Kernza® by The Land Institute, is a cool-season low-input perennial grass that can be managed to produce grain and biomass while providing desired environmental benefits such as soil conservation and nutrient cycling. We are conducting an experiment located in Eastern Nebraska through the multi-institution Kernza CAP, focusing on analyzing Kernza yields at different nitrogen rates, timing, and sources in years 1 and 2 (fall 2021 through summer 2023). This trial evaluates different fertilizer management practices for Kernza compared with annual cropping systems (corn and soybeans), where a previous crop (oat) was implemented before planting Kernza. Grain yield, biomass production, stand counts, and plant heights, as well as lodging, weed, and forage assessments, were evaluated in the first two years of the project. We detected a few differences between agronomic qualities (plant height, lodging, weeds) in year one, although there were less lodging and fewer weeds in the fall-applied N treatment. Preliminary analysis of year 1 results suggests that fall-applied manure and split-applied (fall-spring) N applications yielded higher than some of the spring-applied treatments at higher N rates. Assessments and observations from year two will also be included in the presentation.

Biodiversity of Intercropped Corn or Sorghum with Alfalfa in Establishment Year

Authors: *Haley M. Mosqueda (North Dakota State University)**

Traditional cropping systems such as corn (*Zea mays* L.) and sorghum (*Sorghum bicolor* (L.) Moench) require high fertilizer, herbicide, and pesticide inputs. Over time, these systems will be less productive as high inputs and low diversity alters the soil microbiome and physiochemical properties. Cropping system diversification by including perennial legumes such as alfalfa (*Medicago sativa* L.) can improve soil and increase overall yields. However, despite the benefits it can have on soil quality, alfalfa production is declining because its establishment year is often less productive, resulting in declining interest from producers to introduce the perennial into their cropping systems. The objectives of this three-year study are to reduce the economic loss to farmers in the seeding year and determine whether intercropping corn or sorghum with alfalfa during establishment can increase the overall yield and quality of the perennial system. Nine treatments consisting of corn (C), sorghum (S), and alfalfa (A) alone or intercropped (corn (CA) or sorghum (SA) with alfalfa) were planted in two North Dakota locations using different management strategies: 0.6m gaps every 1.8m within corn rows (G, corn gaps; GA, corn gaps with alfalfa) or a two-harvest system of forage sorghum 45 and 90 days after planting (S2, two-harvest sorghum; SA2, two-harvest sorghum with alfalfa). Light interception, soil characteristics, insect diversity, biomass and corn grain yield, and forage nutritive value were measured. Protein was significantly greater in S2 (94.0 g kg^{-1}) and SA2 (89.9 g kg^{-1}) than S (71.8 g kg^{-1}) and SA (61.2 g kg^{-1}). Dry matter was similar across all sorghum treatments, and the reduction of grain yield in G and GA was less than 17% as compared with C and CA.

Alfalfa failed to establish under SA, however, it maintained similar stands in SA2 compared with A. Yields and nutritive value for alfalfa in year two are expected to be similar across GA and SA2 when compared to A.

Companion Cropping of Spring Canola and Spring Peas in Eastern Oregon

Authors: *Don J. Wysocki (Oregon State University)**

Companion cropping is a strategy of growing various crop species together to take advantage of crop synergies. Companion cropping of spring canola and spring peas can save on nitrogen fertilizer and lowered disease and insect pests. The peas hold on to the canola, improving canola seed shatter tolerance, while keeping peas off the ground, reducing disease risk, and making combining easier. Other benefits include better utilization of available inputs and resources, improved fertilizer and water use efficiency, improved soil health, and reduced weed pressure. Fifteen combinations of seeding rates of pure canola, pure peas, and mixed seed ratios of canola and peas were investigated to determine optimum sowing combinations for companion cropping of these species. At prevailing prices, five combinations of canola and peas together had gross returns greater than pure stands of canola or peas.

How the Feed in Focus (FIF) Program is Helping Farmers to Achieve Their Conservation Goals

Authors: *Ricardo Costa (The Nature Conservancy)**

To support The U.S. Dairy Net Zero Initiative (NZI), the Dairy Feed in Focus Program (FiF) has developed a replicable program and toolset to scale the adoption of conservation practices on dairy farms. These practices are expected to significantly benefit climate change mitigation, enhance soil health, and improve water quality on dairy farms of all sizes. FiF provides data tracking, technical support for implementing best management practices (BMPs), Monitoring, Reporting, and Verification (MRV), and incentive payments for participating farmers who adopt conservation practices. In 2022, dairy farmers received support to implement over 2000 acres of conservation practices under FiF. TNC will share the program design, implementation, and scalability details during this session. We will highlight nuances that make this program replicable in other geographies and with other milk cooperatives, processors, and brands. Although other similar initiatives exist, our program has some key differentiators, including a tiered “menu” approach that allows for multiple entry points to support all management systems and stages of conservation adoption, targeted agronomic advice and incentives for farmers; a bottom-up approach to meeting value chain goals and industry commitments; less complexity in data collection and reporting requirements; and incentives for data access and the adoption of conservation practices.

Subject: Conservation Models, Tools, and Technologies

Location: Room 314 on Main Level

Time: 3:30 PM - 5:00 PM

Developing a Model to Evaluate Prairie Strip Placement

Authors: *Kelly Nascimento Thompson (Iowa State University)*; Brian Gelder (Iowa State University); Richard Cruse (Iowa State University)*

The Daily Erosion Project (DEP) is a daily runoff and erosion estimation tool that estimates sheet and rill erosion losses using the WEPP (Water Erosion Prediction Project) model across the western Corn Belt. Estimating soil erosion is essential for conservation planning purposes to quantify its impacts on crop production and water quality and suggest alternative practices. This study aimed to model the impacts of prairie strip placement on erosion estimates from individual hillslopes at two established sites, each having paired watersheds with (TRT) and without prairie strips (CTL). Models were run across the years 2007-2022. We used existing geo-referenced data layers of climate, slope, and soil specific to these two locations to run WEPP through the Windows interface. This study modeled three different tillage systems – fall moldboard plow (FMP), fall mulch till, and no-till; all sites were a corn-soybean rotation. Fall moldboard plow was the most erosive management for all sites, followed by mulch-till and no-till. Model results for CTL and TRT at the MCN site implementing FMP revealed a hillslope soil loss decrease from 5.25 to 4.57 tons/ha/year or 13 % with the addition of prairie strips.

Furthermore, hillslope soil loss decreased from 3.38 to 2.68 tons/ha/year at the WOR site, giving us a 21% reduction under the FMP system. Adding Bluestem Prairie to the hillslopes resulted in deposition across all the tillage management for both the MCN and WOR sites, indicating favorable model performance. The prairie strips' effectiveness is explained by higher deposition in the prairie system in trapping sediment because high plant stem density slows water runoff velocity resulting in sediment deposition. Future steps for this research include comparing modeled hillslope soil loss estimates against monitored results in these watersheds. While our current modeling system is functioning and giving reasonable results, a field validation step is critical and will be pursued.

Estimating Evapotranspiration of Perennial Grasses under Integrated Landscape Management System Using Machine Learning

Authors: *Julian Cacho (Argonne National Laboratory)*; Jeremy Feinstein (Argonne National Laboratory); Colleen Zumpf (Argonne National Laboratory); John Quinn (Argonne National Lab); DK Lee (University of Illinois at Urbana-Champaign); Cristina Negri (Argonne National Laboratory)*

Co-production of row crops and dedicated perennial bioenergy crops using the Integrated Landscape Management (ILM) approach has the potential to make agricultural landscapes multifunctional, resilient, and sustainable. Under ILM, row crops are grown in highly productive areas, while high-yielding (advanced) perennial bioenergy crop cultivars are produced in marginal areas or parts of the landscape considered to be sub-optimal (i.e., consistently producing uneconomical yield) for row crops and susceptible to environmental degradation (e.g., high potential for nutrient and pesticide leaching, soil erosion, etc.). While the sustainable integration of perennial bioenergy crops into agricultural landscapes can address land use change concerns of large-scale production terrestrial-based bioenergy feedstocks and provide multiple ecosystem services such as reduction in greenhouse gas emissions and nutrient leaching, these benefits must be evaluated against possible tradeoffs such as impacts on the hydrologic cycle. Although perennial bioenergy crops are known to have high

water use efficiency, impacts on evapotranspiration (ET) must be evaluated to inform efforts on the sustainable management of water resources in a changing climate and agricultural production intensification. Estimating ET of advanced bioenergy crops in an ILM production system poses a challenge using traditional methods since marginal areas usually exists in small patches of lands that are sparsely distributed around croplands. This challenge can be addressed using machine learning (ML) if relevant dataset is available for model training, validation, and testing. This study will present preliminary results of an ML-based model for estimating ET of perennial grasses grown on marginal croplands of the Midwest using datasets generated from five study sites across four states in the region.

Expanding the Daily Erosion Project from Agricultural Areas to Forests

Authors: *Timothy J. Sklenar (Iowa State University)*; Brian Gelder (Iowa State University); Chunmei Wang (Iowa State University; Northwest University); Xuegang Mao (Northeast Forestry University); Daryl Herzmann (Iowa State University); Richard Cruse (Iowa State University)*

The Daily Erosion Project (DEP) is an erosion modeling framework that utilizes various remotely sensed products to generate inputs for Water Erosion Prediction Project (WEPP) model to estimate hillslope sheet and rill erosion losses for HUC12 watersheds across all or part of eight Midwestern US states every day. The DEP framework is currently restricted to agricultural land cover and non-agricultural land is ignored. In order to address this limitation and expand the functionality of the DEP to forest lands, new algorithms have been developed to create the necessary inputs for DEP.

Forest management files were assigned with 10% canopy cover increments for each 30m pixel using the US Forest Service's (FS) LANDFIRE canopy cover database. These files were developed from different plant and management parameters found in other USFS sources (WEPPcloud, FS WEPP, Burn Area Emergency Response WEPP). Additionally, hillslope erosion estimates are truncated at roads, channels, non-forested areas, and areas of high flow concentration so that sheet and rill erosion predictions are not made in areas where other types of erosion may dominate.

Model results from 3 forest HUC12s in northeastern Minnesota show very low overall detachment (maximum of around 0.02 tons/acre/year) with differing results depending on which USFS source was used to parameterize management files. Other factors that may be addressed during continued expansion and improvement of forest DEP include the parameterization of forest soil files when there is missing data in the soils database (gSSURGO) and the dynamic parameterization of forest characteristics (canopy height, rooting depth, LAI, etc.) to capture more accurate erosion simulations as the forest changes over time. The addition of these estimates to DEP furthers soil erosion modeling and will enable future analyses into erosion forms and dynamics across different geospatial and temporal scales.

Improving Land and Soil Ecosystem Services in Houston, Texas, through Multidisciplinary Framework That Encourages Consistent Methods for Large-Scale Tree Planting and Native Grass Bioswales to Increase Sustainable Land Use and Water Pollution Reductions

Authors: *Deborah January-Bevers (Houston Wilderness)*; Walter Bevers (Houston Christian University)*

Through a multi-partner, large-scale targeted native trees, and grasses framework, implemented in Houston, Texas, thousands of high-ranking tree species, prioritized based on their respective levels of GHG and water absorption and carbon sequestration, are being planted in locations that experience substantial flooding, have

high rates of health effects exacerbated by air and water pollution and experience multiple days of elevated heat. The region's clay-rich soil composition, made up largely of vertisols and alfisols, influence watershed infiltration and non-point source runoff, especially during heavy rain events, and affect environmental enhancement and recovery efforts due to the dynamics of various commercial industries that intersect with riverine systems and coastal wetlands. Regional programs that effectively provide large-scale conservation models and accompanying tools are discussed, including the Houston Ship Channel Trees and Riparian Enhancement of Ecosystem Services (HSC T.R.E.E.S.) Program – providing thousands of targeted large-scale tree species on industrial properties along the 25 miles of the Houston Ship Channel, and the Riverine Targeted Use of Buyouts (Riverine TUBs) Program - prioritizing FEMA-qualified contiguous buyout properties adjacent to riparian corridors leading to Galveston Bay, and providing ecosystem services through large-scale targeted native tree plantings and creation of native grass bioswales on the recovered green spaces. The multidisciplinary framework includes engagement of multisectoral leadership broadened beyond those traditionally working on climate change resilience – including school district leadership, health departments, major energy and gas companies, and native tree and grass growers. School leaders recognize the growing need to provide instructional opportunities to develop increased knowledge on the effects of climate change and implement conservation tools to directly benefit the future of their communities.

Subject: Outreach, Education, and Community Engagement

Location: Room 315 on Main Level

Time: 3:30 PM - 5:00 PM

Communicating Conservation and Climate Smart Funding Opportunities

Authors: *Jean Brokish (American Farmland Trust)*; Helen VanBeck (American Farmland Trust)*

The influx of funding to support climate-smart practices provides both an exciting opportunity to advance conservation goals and an obligation for the conservation community to clearly communicate program information. To assist with the need to communicate conservation and climate-smart funding opportunities, the Illinois Sustainable Ag Partnership published a Cover Crop Incentive Directory in October 2022. The directory provides a clear comparison of 15 distinctive programs that offer payment incentives to Illinois farmers for growing cover crops, including publicly funded programs at the federal, state, and county levels, as well as privately funded programs throughout Illinois. A brief description, relevant geography, contract length, payment details, and contact information are provided for each program, providing side-by-side comparisons to help farmers select the option that is best for their operation. The Directory also includes a "Stacking Matrix" to help farmers understand which programs can be combined to receive multiple incentives.

Feedback received from the Incentive Directory has been positive and serves as a framework to convey information on additional funding opportunities. ISAP will soon be releasing a directory for edge-of-field practice incentives and is creating a directory of opportunities available through USDA's climate-smart commodities partnership program. We believe this framework can serve as a model for other groups working to advance the adoption of climate-smart practices.

Equity in Conservation Outreach through Cooperative Agreements

Authors: *Joe Otto (SWCS); Jill Reinhart (USDA-NRCS)**

NRCS first awarded Equity in Conservation Outreach cooperative agreements in 2022, partnering with 117 entities to help NRCS increase access to our programs and services. Fifty million dollars was made available to partners working with historically underserved producers, communities, and students. Of these 117 partners, 85 were new partners NRCS had not worked with previously, 15 were tribal agreements, seven were with Historically Black Colleges and Universities (HBCUs) and 1890's Foundation agreements, and two were with Hispanic Serving Institutions (HSIs). These projects have hosted workshops and trainings, assisted in signing customers up for conservation practices, developed local leaders, assessed barriers to program participation, and provided internship opportunities and mentoring to minority students about careers in agriculture and natural resources. This presentation will highlight the Equity in Conservation Outreach funding opportunity, and the great work being accomplished to realize equity, diversity, and inclusion in the work of NRCS. If funded project partners are attending the conference, they will be invited to participate in this presentation and be available to answer questions. To date, only about six months into the work of these agreements, about 270 events and 115 workshops have been held, attended by 7,500 people. Over 14,000 people have been reached by awardee outreach activities. Eighty-five new conservation program sign-ups can be directly attributed to awardee outreach. Equity in Conservation Outreach projects is identifying program participation barriers and making recommendations to overcome barriers that can be utilized by all conservation professionals. These findings will be shared with participants to expand the reach of the conclusions, and their application to conservation work more broadly.

Overview of the Soil and Water Conservation Laboratory Manual, and Open Textbook

Authors: *Colby J. Moorberg (Kansas State University)**

There is a large demand for both soil conservationists and professionals with expertise in soil health. This has highlighted the need for college course offerings and supporting materials for training students to meet this demand. The open textbook, *Soil and Water Conservation Laboratory Manual* was recently developed for upper-level undergraduate and graduate-level courses. The laboratory manual was developed to compliment the open textbook, *Soil and Water Conservation: An Annotated Bibliography*. As with that annotated bibliography, the manual was created in Pressbooks, an online open textbook publishing platform. The manual was designed using a scaffolding approach wherein each laboratory activity builds on previous ones and guides students toward the development of a conservation plan for their study site. The manual includes sections on site evaluation, conservation practices, virtual field trips, predicting soil erosion, and developing a conservation plan. As students progress through the manual, they will collect onsite data including a soil health assessment using the USDA-NRCS In-Field Cropland Soil Health Assessment, learn to use the LandPKS app, explore potential conservation practices, and model soil erosion rates under existing conditions and after conservation practices have been implemented. This information is then included in a conservation plan that serves as a semester project. This overview of the laboratory manual will include reflections on experiences from using the manual for both face-to-face and online delivery of soil and water conservation courses. The *Soil and Water Conservation Laboratory Manual* has great potential for helping meet the demands for soil health experts and soil conservationists.

Subject: Soil Health Resources, Indicators, Assessment, and Management

Location: Room 316 on Main Level

Time: 3:30 PM - 5:00 PM

Can We Improve Fragipan Soils' Health Adopting Annual Ryegrass Cover Crop?

Authors: *Amitava Chatterjee (USDA-ARS)*; Dana Dinnes (USDA-ARS); Gavin Simmons (USDA-ARS); Jeff Cook (USDA-ARS); Peter O'Brien (USDA-ARS); Dan Olk (USDA-ARS)*

Fragipan soils are characterized by dense subsurface layers that severely restrict water flow and root growth, which then impede the accumulation of soil organic carbon (C). These soils normally have a perched high-water table in the winter and early spring, leading to excess water and shallow rooting. In the summer, because of a limited rooting depth, crops are prone to drought conditions under high evapotransport demands. Farmers have observed that addition of annual ryegrass (*Lolium multiflorum*) into their cover crop management regimes has improved their field drainage during the wet portions of the year and reduced crop water stress during the summer, and in some years have then recorded greater yields. Two on-farm experiments, at Marion, Illinois, and Hamilton County, Illinois, were initiated to determine the role of annual ryegrass as winter cover on soil profile C and water dynamics. Both fields are under a corn (*Zea mays*)-soybean (*Glycine max*) rotation paired with and without annual ryegrass as winter cover crop. Soil samples were collected using a hydraulic probe. Soils were separated into depth increments of 0-15 cm, 15-30 cm, 30-45 cm, and 45-60 cm. Soils were analyzed for moisture content, particle size distribution, total C, nitrogen, pH, and Mehlich 3- extractable nutrients. Influence of cover crop on changes in soil moisture and properties will be presented.

Cover Crop Effects on Yield and Soil Health in Iowa

Authors: *Matthew E. Carroll (Iowa Soybean Association)*; Suzanne Fey (Iowa Soybean Association); Aaron Prestholt (Iowa Soybean Association); Roger R. Wolf (Iowa Soybean Association); Anthony Martin (Iowa Soybean Association)*

The effects of long-term cover crop usage on yield and soil health measurements in the standard corn-soybean rotation that is commonly practiced by Iowa farmers have not previously been tested in large on-farm trials. As of 2019, it was estimated that 2.2 million acres of Iowa cropland were planted into cover crops, which is significantly below the goal set by the Iowa nutrient reduction strategy of 12.5 million acres. In this study, done in collaboration with the soil health partnership, long-term cover crop strip trials were established across the state of Iowa. In total, 24 locations across 108 sites years were analyzed for both yield response and soil health changes over time. This data set includes the yield and Haney soil test results from 2016 to 2022. The objectives of this study are to summarize the expected soil health and yield responses in farmland that has been in a cover cropping system across multiple years. There is a frequent perception among farmers that cover crops reduce yield in corn and soybean fields that follow cereal rye. The results from this study show that after the first year of cover crop implementation, there is no consistent yield loss in corn or soybeans. This work can help farmers and agronomists make more informed, data-driven decisions about what to expect from cover crop implementation on their farms.

Decomposition and Nitrogen Release from Grass and Legume Cover Crops in Eastern Nebraska

Authors: *Tauana Almeida (University of Nebraska - Lincoln)*; Andrea Basche (Department of Agronomy and Horticulture - University of Nebraska-Lincoln)*

Cover crops have the potential to scavenge residual N and release it to subsequent crops, creating the potential for enhanced NUE but results will vary year to year. The objective of this study was to investigate the decomposition of cover crops and the nitrogen (N) release throughout the cash crop growing season, given the nutrient release is influenced by the amount of biomass and the plant residue quality. During the corn growing seasons of 2021 and 2022 litterbags were placed in an experimental field located at the Eastern Nebraska Research and Extension Center (ENREC), near Mead, Nebraska. The treatments evaluated consisted of cereal rye, hairy vetch, and a cereal rye/hairy vetch mixture. The cover crop treatments were established in the fall following oats. The cover crops were terminated in the spring and corn (*Zea mays* L.) was planted as cash crop. One day before cover crop termination, 1 m^2 of aboveground biomass was sampled, divided into six equal parts and six bags of 5 mm^2 mesh size were filled with the cover crop residue and placed in the field. The bags were retrieved throughout the corn growing season at 0, 2, 4, 8, 12 and 16 weeks after cover crop termination. The cover crop residue from the bags was analyzed for C and N content by dry combustion. In 2022 the biomass produced by cereal rye and mixture was half of the biomass produced in 2021. The decomposition rate, the mass remaining and the nitrogen released and remained at the end of the season varied from year to year. In 2022, in general the cover crops decomposed 30% less than in 2021. In 2022 hairy vetch release a higher amount of N than the other treatments. The observed reductions in cover crop biomass production, cover crop decomposition, and corn grain yield in 2022, are an indicative that drought period is impacting not only the cover crops development, but also determining how cover crop is impacting the cash crop growth..

Physical and Hydraulic Soil Health Indicators in Some Annual and Perennial Cover Crops in Georgia

Authors: *Chandler Gruener (University of Georgia)*; Matt Levi (University of Georgia); Nicholas Basinger (University of Georgia); Nandita Gaur (University of Georgia)*

Soil health is commonly measured with a diverse suite of dynamic soil properties to represent the potential function of a given soil. Physical and hydraulic property measurements are frequently included as soil health indices because they are sensitive to management over short time periods; however, collecting sufficient replicates of these properties is challenging due to time and cost constraints. One approach to increase the potential for more rapid data collection is to utilize new technology. For example, computerized methods to measure hydraulic conductivity using SATURO have been introduced, and the use of instrumentation to evaluate aggregate stability is a newer area of research for finding a more rapid approach. We explored the relationships between aggregate stability measured by both laser diffraction and the standard wet-sieving approach to bulk density, hydraulic conductivity, and water retention measurements for soil surface samples (0-5 cm). All parameters were sampled at the soil surface for the greatest impact from four cover crop treatments commonly used in the Georgia Piedmont. Treatments included cereal rye (*Secale cereale*), crimson clover (*Trifolium incarnatum*), perennial white clover (*Trifolium repens* var. 'Durana'), living mulch, and bare ground. After two years of study, there were treatment differences for multiple properties, but differences were not significant after three years. The mean bulk density in the living mulch was significantly lower than the cereal rye after two years (0.18 g cm^{-3} difference). After two years, the living mulch also had a faster hydraulic conductivity by 18 cm hr^{-1} than crimson clover. Our results will explore interactions between physical and hydraulic soil properties over time by treatment. Living mulch creates a viable approach for producers to realize benefits and soil health improvements in areas that can maintain it properly.

Subject: Water Resource Assessment and Management

Location: Room 317 on Main Level

Time: 3:30 PM - 5:00 PM

A Watershed Approach to Municipal Source Water Protection

Authors: *Mary Beth Stevenson (City of Cedar Rapids)**

How does a city that benefits from a strong economic relationship with agriculture respond when nitrate pollution from upstream farm fields threatens its drinking water supply? The City of Cedar Rapids faces this very situation. Large industries in Cedar Rapids process millions of bushels of corn and soybeans on a daily basis and are a critical part of the local economy. At the same time, periodic spikes in nitrate pollution originating from agricultural fields threaten the City's drinking water supply. If nitrate concentrations reach a point where they exceed levels safe for public health, the City will need to install an expensive nitrate removal system. Situated at the downstream end of the Cedar River Watershed, which is home to some of the most productive agricultural land in the nation, the health of the Cedar River and the City's drinking water supply is reliant upon upstream farmers implementing conservation measures to reduce nitrate runoff to rivers. For a variety of reasons, farmers are not implementing nearly enough practices to adequately safeguard drinking water supplies for rural residents and Cedar Rapidians alike. The City is taking a proactive approach to protect drinking water supplies by supporting on-farm nutrient reduction efforts and developing relationships with agricultural stakeholders in the watershed. These investments of financial and human capital have led to meaningful partnerships with key allies around the watershed and the State, and have contributed to more nutrient reduction practices implemented on the ground. This presentation will highlight new projects and initiatives the City has launched in the past two years to reach beyond its borders and to communicate a critical message to agriculture: when it comes to source water protection, every acre matters.

Development of a Hillslope Hydrologic Monitoring Site in a Riparian Pasture/Row-Crop Setting for the Study of Aquifer Recharge, Erosion, and Groundwater-Surface Water Interactions

Authors: *Andrew M. O'Reilly (USDA Agricultural Research Service)*; Samiul Alim (University of Mississippi); Robert Holt (University of Mississippi); Craig Hickey (University of Mississippi); William Rossell (USDA Agricultural Research Service)*

Agricultural land management practices affect the partitioning of precipitation into runoff, evapotranspiration, and infiltration, thereby impacting downgradient groundwater and surface water resources. Hydrogeophysical methods are being applied to define the spatiotemporal variability of hydrologic processes along a transect covering a hillside pasture adjoining a flat riparian row-crop field. The site is within the Goodwin Creek Experimental Watershed (GCEW), which is a 2,100-ha mixed land use catchment (pasture, row crop, and pine and hardwood forest) in northwest Mississippi. The creek is a headwater tributary of the Yocona, Yazoo, and Mississippi Rivers. Surface and internal erosion are common in GCEW due to fine-grained soils, ground surface slopes >10%, and focused subsurface flow. High runoff also limits water available for aquifer recharge. Goals of the research site include assessment of conservation practices that can reduce the volume and velocity of runoff while increasing recharge, such as contour grading of berms/swales, check dams, and on-farm reservoirs. Data collection will consist of a transect of five wells in the perennial water-table aquifer and one well in the underlying regional aquifer. Adjacent to each of the water-table wells, soil moisture content, temperature, electrical conductivity, and matric potential will be measured. An electrical resistivity tomography (ERT) profile has been acquired along the 501-m transect, showing that the aquifer is relatively thin (<10 m) near the creek

and thick (>30 m) under the pasture. The depth to the top of the aquifer is variable, outcropping or thinly confined over a short distance (<10 m) in the pasture but confined on both sides of the outcrop. Soil samples were collected down to 1.5 m at multiple locations along the profile. Collected soil samples were generally consistent with the ERT results, showing downward coarsening texture in the outcrop area and fine-grained texture in the confined area.

Impact of No-Till, Cover Crops, and Tile Drainage on Soil Moisture Dynamics within the Root Zone

Authors: *Ajoy K. Saha (South Dakota State University)**

Agricultural conservation practices can improve soil hydraulic function within the root zone by improving soil structure, increasing organic matter, and enhancing infiltration and water-holding capacity. In the field, soil moisture varies (excess in spring and deficit in summer) throughout the growing season and is often a limiting factor for crop productivity in the Northern Great Plains in the USA. This study aimed to evaluate the impact of cover crops, tillage practices, and tile drainage on soil moisture variation from August 2020 to September 2022 within the soil profile (from the ground surface to 120 cm soil depth). The field experiment was conducted in 24 plots (9.1 m x 91.5 m) in the tillage-rotation study at the South Dakota State University Southeast Research Farm (SERF) near Beresford, South Dakota. Sentek Triscan Bluetooth-enabled soil moisture probes were installed to monitor soil moisture in treatments of conventional till and no-till, with and without cover crops, and with and without tile drainage. In each plot, soil moisture data were generated hourly for 12 different depths (at 0-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60-70, 70-80, 80-90, 90-100, 100-110, 110-120 cm below the ground surface). While in-depth analysis has not yet been completed on this dataset (around 170,000 data points), preliminary data and analysis indicate that all treatments: tillage, cover crop, and tile drainage practices, influence soil water content within the soil profile. The no-till (NT) systems conserved 9.8% higher plant available soil moisture during the crop growing season (May-September) than conventional tillage (CT) systems. Cover crop and drainage practices had no significant on soil moisture dynamics. Therefore, the NT system could be vital in conserving more soil moisture and would be more resilient in managing weather extremes (drought).

Impacts of Biochar and Cover Crops on Soil Hydraulic Properties in Sandy, Sloping, and Low C Soils

Authors: *Humberto Blanco (University of Nebraska-Lincoln)*; Cody Creech (University of Nebraska-Lincoln); Rhae Drijber (University of Nebraska-Lincoln); Amanda Easterly (University of Nebraska-Lincoln)*

Adopting innovative management practices to enhance the ability of low C, sandy, and sloping soils to absorb and retain water in the face of fluctuating climates (i.e., droughts, intense rainfall) is of paramount importance. Adding biochar and cover crops offers promise, but previous research did not specifically focus on vulnerable soils or on the potential synergistic effects between biochar and cover crops. This 4-yr project assesses how woody biochar application at different rates (0, 6.25, 12.5, 25, and 50 Mg ha-1) and three cover crop treatments (no, single species, and multiple species mix) affects soil hydraulic properties across three soils (sandy/low C, sloping, and nearly-level/semiarid) under no-till cropping systems in the central Great Plains. Results after 3 yr show that cover crops failed to establish at the semiarid site due to limited soil moisture, while they produced low amounts of biomass (0.6 Mg ha^{-1} average) at the sandy/low C and sloping sites. Biochar application at high rates significantly impacted soil hydraulic properties in sandy (low C) and sloping soils but not in the nearly-level soil (semiarid site). Biochar application at 50 Mg ha^{-1} increased initial water infiltration, volumetric water content at field capacity (-33 kPa matric potential), and plant available water in the sandy (low C) and sloping soils in the short term. Results suggest that any synergism between biochar and cover crops may be limited in the short

term. Overall, biochar impacts are site-specific and that large amounts (50 Mg ha^{-1}) of biochar may be needed to significantly improve soil hydraulic properties in environmentally sensitive soils; however, high application rates of biochar may not be economical or practical for large-scale application.

TUESDAY, AUGUST 8

ORAL PRESENTATION DESCRIPTIONS AND AGENDA

Subject: Adaptive Management of Conservation Efforts

Location: Room 314 on Main Level

Time: 10:30 AM - 12:00 PM

Addition of Biochar Decreased Soil Respiration in a Permanent No-Till Cover Crop System for Organic Soybean Production

Authors: *Ratih Kemala Dewi (Tokyo University of Agriculture and Technology)*; Yingting Gong (Institute of Agricultural Resources and Environment, Guangdong Academy of Agricultural Sciences); Huang Qiliang (Tokyo University of Agriculture and Technology); Peiran Li (State Environmental Protection Key Laboratory of Environmental Pollution Health Risk Assessment); Rahmatullah Hashimi (Tokyo University of Agriculture and Technology); Masakazu Komatsuzaki (Ibaraki University)*

The increase in soil carbon sequestration under long-term no-till (NT) and cover crop (CC) management has been shown to form part of a sustainable agricultural management system. Along with the increase in soil organic carbon (SOC), soil respiration in this system was also enhanced by the increased soil temperature through the decomposition that causes carbon loss from the soil. To overcome this issue, biochar can be applied. However, the addition of biochar into this system is not well studied. Therefore, the aim of this study was to investigate the effect of this system on soil respiration. The experiment was conducted at the Center for International Field Agriculture Research & Education, Ibaraki University. Long-term tillage practices, such as NT and moldboard plowing (MP), CC such as rye (RY) and fallow (FA), and biochar application either with biochar (WB) and no biochar (NB) were applied to a split–split plot in a randomized complete block design with four replications. The daily CO_2 flux was measured every week at 9:00–11:00 a.m. Tillage and cover crop affected the daily soil respiration in the soybean growing season, with the NT practice having higher daily CO_2 flux than that in MP. Biochar addition reduced the soil respiration in both soybean and cover crop growing seasons. Moreover, the addition of biochar to these systems was able to reduce the annual CO_2 emissions in both 2020 and 2021. The values of these emissions ranged from 9.63 Mg ha^{-1} for MP FA WB to 18.92 Mg ha^{-1} for MP RY NB in 2020 and from 7.52 Mg ha^{-1} for MP FA WB to 13.67 Mg ha^{-1} for NT FA NB in 2021. The addition of biochar into this system was able to reduce soil respiration by regulating the soil temperature, and soil moisture, and protecting the SOC from decomposition. Biochar addition also increased the SOC and decreased the soil bulk density, which improves soil porosity. Therefore, these findings would be very useful to be included within the global scenario of soil organic matter management.

Intensifying a No-Till Sorghum-Soybean-Winter Wheat Rotation with Double Crops and Cover Crops

Authors: *Kraig Roozeboom (Kansas State University)*; Peter Tomlinson (Kansas State University); Matthew Nielsen (Bayer Crop Science); Alexis L. Correira (Kansas State University); Jessica Grunberg (Kansas State University)*

More intense cropping systems have been associated with improved ecosystem services, particularly relative to soil properties. However, cropping system intensity must be calibrated to the environment. The objective of this research was to quantify the effects of intensification via double crops and cover crops on cropping system productivity. Individuals interested in balancing cropping system intensification with available environmental resources will benefit from this presentation. Crop yields were determined for all crops during the fourth cycle of a three-year, no-till, sorghum-soybean-winter wheat rotation from 2016 through 2021. Six versions of the rotation with a range of intensities were compared. The fraction of time with a growing crop or cover crop during the rotation ranged from 0.52 for to 0.92. All phases of the rotation were present every year. Sorghum, soybean, and wheat yields often responded to system intensity, but the magnitude and direction of response varied with year and crop. Total grain yield for the rotation was greater for the treatment intensified only with double-crop soybeans compared to all other treatments. Other treatments produced yields similar to the least intense check treatment. These results illustrate that opportunities exist to intensify this cropping system with either no reduction in total rotation productivity or increased productivity, although timing and species of additional crops must be managed carefully. An improved understanding of the environmental limits imposed on intensification will better inform recommendations for enhancing ecosystem services in no-till cropping systems while maintaining grain production, the primary determinant of economic returns. Subsequent work should focus on quantifying the effect of intensification on soil physical, chemical, and biological properties.

Long-term No-tillage and Rye Cover Crop Systems Improve Soil Water Retention by Increasing Soil Organic Carbon in Andosols, Kanto, Japan

Authors: *Rahmatullah Hashimi (Tokyo University of Agriculture and Technology)*; Junko Nishiwaki (Tokyo University of Agriculture and Technology); Huang Qiliang (Tokyo University of Agriculture and Technology); Ratih Kemala Dewi (Tokyo University of Agriculture and Technology); Masakazu Komatsuzaki (Ibaraki University)*

Soil organic carbon (SOC) and soil hydraulic properties are the important indicators of soil quality and may differ among different tillage systems. Maintaining optimum soil water retention (SWR) is a huge challenge for crop production. However, the response of SOC and SWR to long-term NT and cover crops systems has not been well addressed. This study aimed to evaluate the effect of NT and moldboard plow (MP) tillage systems combined with rye (RY) and fallow (FA) cover crop treatments on SOC, active carbon (AC), water-stable aggregates, mean weight diameter (MWD), bulk density (BD), aggregate-associated carbon, and SWR. NT significantly increased the >4 and 2 mm aggregates, aggregate-associated C at the 0–2.5 and 2.5–5 cm depths, field capacity, total plant available water content accumulation at all depths and SWR at all depths between 0 and 15 cm. RY cover crops significantly increased aggregate-associated carbon at the 2.5–5 and 5–10 cm depths in both NT and MP and SWR at the 10–15 cm depth. NT combined with RY significantly increased SOC and AC in the surface layer and water content at all soil depths. Path analysis revealed that SOC and MWD were correlated with plant available water content (PAW) and field capacity (FC) under the NT system and is the primary reason for the observed increase in SWR. Thus, the NT system increased plant residue, keep soil moisture, increased SOC content and SWR, and bonded soil microaggregates into macroaggregates better than the MP system. Therefore, the use of RY-based NT system can be used as a sustainable management practice that contributes to water saving and reduces the drought effects brought on by climate change.

Maximizing Cover Crop Biomass Production in Corn-Based Systems: Case Studies and Modeling

Authors: *Sabrina J. Ruis (USDA-ARS)*; Humberto Blanco (University of Nebraska-Lincoln)*

Many scientists, stakeholders, and policymakers advocate for the use of cover crops (CC) to enhance soil health indicators. However, low or variable CC biomass production, which is often the case in corn-based systems, can limit CC impacts on soil health indicators. Thus, research was conducted to define what strategies could be used to enhance and stabilize CC biomass production in corn-based systems? Our objective was to assess how: 1) interseeding CC into standing crops, 2) terminating CCs late, and 3) planting CCs following a short-season crop affected CC biomass production using field experiments and studying the amount and annual stability of the CC biomass produced using the Agricultural Production Systems Simulator (APSIM). Interseeding a winter rye CC into standing corn or soybean in September improved CC biomass production a rainfed site, but not an irrigated site compared with drilling after harvest. However, CC biomass production was typically highly variable, ranging from 0.02 to 0.92 Mg ha^{-1} at the rainfed site and 0.07 to 1.03 Mg ha^{-1} at the irrigated site. Terminating a winter rye CC late (at corn planting) increased CC biomass production compared with terminating 2-3 weeks before corn planting in all years at both a rainfed and an irrigated site. The gain in CC biomass varied from 0.03 to 3.6 Mg ha^{-1} at the rainfed site and 0.5 to 4.3 Mg ha^{-1} at the irrigated site. Following winter wheat (short season crop), CC biomass production varied from 0.1 to 7.4 Mg ha^{-1} depending on location and CC species. The highest CC biomass following winter wheat was observed for sunn hemp and sorghum-sudan grass. Overall, the strategies to enhance CC biomass production rank as: planting following a short-season crop > late CC termination > interseeding into standing crops.

Subject: Edge-of-Field Practices and Monitoring

Location: Room 315 on Main Level

Time: 10:30 AM - 12:00 PM

Comparing Vegetated and Unvegetated Shallow Furrow Ditches: Water Quality and Quantity Responses

Authors: *Elizabeth R. Schwab (The Ohio State University)*; Brittany Hanrahan (USDA-ARS); Margaret M. Kalcic (University of Wisconsin-Madison); Kevin King (USDA-ARS); Vinayak Shedekar (Ohio State University); Elizabeth Callow (The Ohio State University)*

Artificial surface drainage practices are used worldwide to enable or enhance agricultural production in poorly drained areas. While designed to remove excess water, these modifications to the landscape present an opportunity to intercept nutrient runoff from agricultural lands that impairs downstream waterbodies. A practice unique to the study region of northwest Ohio, a landscape characterized by largely flat topography and heavy clay soils, is the use of shallow unvegetated furrow ditches for surface water management. However, an improvement to surface drainage is the vegetation of channels or ditches that convey water from agricultural fields in order to reduce flow velocity and nutrient and sediment transport. In this study, we compared event wise nutrient loss (nitrate (NO_3-N), total nitrogen (TN), dissolved reactive phosphorus (DRP), and total P (TP)) between a vegetated and an unvegetated furrow ditch across seasons and precipitation event characteristics. Preliminary results show that statistically significant differences in load-runoff relationships between vegetated and unvegetated furrows are observed only for TP when looking at all precipitation events; however, considering events broken down by different precipitation event characteristics suggests that there are certain conditions (notably, high antecedent moisture condition, low event maximum intensity, and moderate precipitation event size) under which lower loads (for most or all of the four nutrients studied) are seen from the vegetated furrow compared to the unvegetated furrow for a given runoff depth. Similarly, characterizing precipitation events by season highlights seasonal differences in load-runoff relationships, which are most prominent during spring. Results across various dimensions suggest that there may be a positive effect of vegetating these shallow furrow ditches, but that this positive effect is most evident under certain seasonal and precipitation event conditions.

Design Criteria for a New Tile Drainage Conservation Practice in Grass Waterways

Authors: *Keith Schilling (Iowa Geological Survey)*; Matthew Streeter (University of Iowa); Antonio Arenas (Iowa State University)*

Grassed waterways are an effective soil erosion practice, but most are tile drained and discharge N-laden water to streams from row-crop catchments. Midwestern waterways contain fine-textured and nutrient rich alluvial soils and recent evidence suggests that hydrogeologic conditions are conducive for nitrate reductions to occur. A concept for a new conservation practice has emerged that would use waterways deposits for tile drainage treatment by directing a portion of waterway tile into the subsurface for nitrate reductions. In this study we characterized the sedimentology and hydrology of 24 different waterways at 13 sites in Iowa to assess their capacity to provide treatment for waterway tile N loads. Results indicated a range of hydrologic conditions across the various landform regions of Iowa with textures dominated by carbon-rich silt and anaerobic groundwater biogeochemistry. The hydraulic conductivity of the alluvium ranged from 1.1 to 0.02 ft day^{-1} and averaged 0.3 ft day^{-1}. A physically based model was developed to quantify the relation between surface and subsurface flows in a representative waterway to test the performance of potential saturated waterway designs under a wide range of geologic and hydrologic conditions. Results from the study are being used to identify the

best conditions where the installation of a new waterway design could be constructed with the greatest likelihood of success.

Working across Multiple Scales to Assess Effectiveness of Agricultural Practices for Improving Water Quality in Tile-Drained Agricultural Watersheds: Long-Term Assessment from the Mackinaw River, Illinois, USA

Authors: *Maria Lemke (The Nature Conservancy)*; David Kovacic (University of Illinois); Michael Wallace (University of Illinois Urbana-Champaign); William Perry (Illinois State University); Jackie Kraft (McLean County Soil and Water District, Illinois); Terry Noto (Conservation Strategies Consultants, LLC); Krista G. Kirkham (The Nature Conservancy)*

For over 20 years The Nature Conservancy (TNC) in Illinois has worked with agricultural landowners and partners to implement and monitor the effectiveness of agricultural conservation practices on water quality and hydrology in the Mackinaw River watershed, a major tributary to the Illinois River that drains into the Mississippi River and ultimately the Gulf of Mexico. Like much of central Illinois, this 3,000 km^2 watershed contains some of the most productive agricultural land in the nation and plays a key role in the state's economy. Urban development and high nutrient runoff from tile-drained row crop agriculture have stressed freshwater resources, leading to habitat loss and reduced water quality, such that Illinois is one of the highest contributors of nitrogen and phosphorus to Gulf of Mexico hypoxia. Nutrient exports from Mississippi River Basin states led to mandated nutrient loss reduction plans – Illinois has set interim goals of 15% and 25% reduction in nitrate-nitrogen and phosphorus by 2025, with long-term reductions of 45%. A recent 12-year study conducted by TNC, and partners showed small wetlands constructed to intercept and treat agricultural tile runoff reduced nitrate losses by 15-38% and captured 53-81% of dissolved phosphorus. However, increased intensity of spring precipitation events and nutrient losses associated with climate change require additional assessments of single and multi-practice capacity to meet nutrient loss reduction goals. We have increased field-scale wetland analyses to provide more robust assessments of phosphorus removal and cost efficiencies, as well as watershed-scale effectiveness of constructed wetlands. We will also present research on stacked practices at field and watershed scales. Integrating science into collaborative outreach and implementation is necessary to develop and apply sustainable conservation-based solutions at scale to address water quality goals and sustain diversity in agricultural watersheds.

Subject: Soil Health Resources, Indicators, Assessment, and Management

Location: Room 316 on Main Level

Time: 10:30 AM - 12:00 PM

Assessment of Soil Carbon Stocks in Texas Cropping Systems

Authors: *Joseph Burke (Texas A&M AgriLife Research)*; Katie Lewis (Texas A&M Agrilife); Christopher Cobos (Texas A&M AgriLife Research); Paul DeLaune (Texas A&M AgriLife Research); Jamie Foster-Malone (Texas A&M AgriLife Research); Jourdan Bell (Texas A&M AgriLife Extension)*

With an increased interest in carbon (C) sequestration to meet the Paris Climate Accords, scrutiny of agriculture's impact on climate change is a key priority. There is limited information available on how cropping systems can sequester C in Texas because of limited research. To alleviate the lack of knowledge, the Texas Corn Producers, Sorghum Checkoff, and Cotton Incorporated supported a state-wide assessment of soil organic C stocks in Texas corn, cotton, and sorghum production systems. Samples were collected from paired farms that included the primary cropping system grown under traditional and conservation management practices in the Northern and Southern High Plains, Rolling Plains, Blackland Prairies, and Gulf Coast regions of Texas. A total of 23 counties throughout Texas were sampled, consisting of 19 soil series accounting for a total of 18,412,723 acres. Soil samples were collected in 15 cm depth increments to 90 cm and assayed for soil organic C, bulk density, soil characterization, texture, pH, salinity, and inorganic N. Results demonstrated that soil C stocks were greater under conservation systems, in soils containing greater clay concentrations, and in regions with greater precipitation. In semi-arid regions of the state, there was little difference in C stocks between the traditional and conservation cropping systems. In 2023, an additional 24 paired fields will be sampled to broaden the reach of this project.

Enhanced Soil Moisture Estimation Via Intelligent Full Waveform Inversion of GPR Data

Authors: *Seyed Zekavat (Worcester Polytechnic Institute)*; Breeanne Heusdens (Michigan Tech University); Radwin Askari (Michigan Tech University); Snehamoy Chatterjee; Majid Moradikia (Worcester Polytechnic Institute)*

Root Zone soil moisture characterization is key to optimum irrigation, healthy soil mineral content, and water conservation. Ground Penetrating Radar (GPR) has been widely used to estimate soil moisture via Full Waveform Inversion (FWI). The conventional FWI method, however, is susceptible to significant challenges that can cause large result errors, in particular, for complex models such as soil moisture. These challenges include large computational costs or large computational times, the dependency of the method on the starting model accuracy, and data challenges, such as missing low-frequency data and nonlinearity that can render local minima traps and cycle skipping. Intelligent FWI methods using machine learning have been developed to address these challenges. Common machine learning methods use deep learning, deep neural networks, and convolutional neural networks with generative adversarial algorithms. GPRNet is an existing algorithm with an open source that is analogous to FWI and uses a five-layer convolutional neural network. However, GPRNet has been trained via simple models, not suitable to simulate radar data for complex soil moisture models. We use gprMax another open-source code to simulate datasets based on more complex models such as soil moisture to train the GPRNet. Then, we enhance our intelligent FWI method by including the convolutional neural network to increase the accuracy and performance of the new and increasingly complex datasets. We achieve further enhancements by including different filtering methods, changing activation functions, manipulating the number of hidden layers, and altering other parameters and regularization in our algorithm.

Ground Penetrating Radar System Design for Intelligent Root-Zone Soil Moisture Characterization and Optimal Farm Irrigation

Authors: *Seyed Zekavat (Worcester Polytechnic Institute)*; Majid Moradikia (Worcester Polytechnic Institute); Noushin Khosravi Largani (Worcester Polytechnic Institute); Vincent J. Filardi (Worcester Polytechnic Institute); Oren Mangoubi (Worcester Polytechnic Institute); Radwin Askari (Michigan Technological University)*

Optimal farm irrigation is key to both conservations of water and soil resources. High-resolution soil moisture estimation is critical to optimal farm irrigation. This paper investigates high-performance ground penetrating radar (GPR) system design for intelligent root-zone soil-moisture characterization. Specifically, GPR transmitted waveform and signal processing at the receiver will be properly adjusted to facilitate high-resolution range profile (HRRP) estimation. This enables high-performance extraction of backscattered signal features received from different soil layers (with various moisture content). This signal feature information can be used for root-zone soil moisture extraction by applying machine learning (ML). Accurate high-resolution HRRP estimation needs high signal bandwidths, which contrasts with the higher Depth-of-Penetration (DOP) attainable via lower frequency bands. On the other hand, lower frequency bands only support narrower bandwidths. To address all the above concerns and achieve a properly received signal feature for ML via lower frequency bands, techniques of proper waveform design capable of high-resolution HRRP estimation for different transmission schemes will be investigated. Examples of these transmission schemes include stepped frequency continuous wave (SFCW), Frequency Modulated Continuous Wave (FMCW), and Orthogonal Frequency Division Multiplexing (OFDM). Accordingly, appropriate signal processing schemes corresponding to each transmission mode are applied to integrate the signals received across all frequency bands. An inverse problem for end-to-end (starting from the transmission to reception) design will be offered by which we can jointly attain proper waveform, soil moisture imaging, and high-resolution HRRP.

Soil Chemistry Is Not Altered by Adopting Cover Crops and Reducing Tillage in the Early Transitional Period

Authors: *Ivo Muller (Mississippi State University); Joby Czarnecki (Mississippi State University)*; Beth H Baker (Mississippi State University); Jing Hu (Mississippi State University)*

Cropland soil organic matter (SOM) is low in the Lower Mississippi Alluvial Valley. Accordingly, cover crops have been adopted to increase SOM levels in this region. This study's purpose was to observe temporal changes in soil chemistry during the early stages of conservation adoption to inform adaptive management in systems where the potential for considerable SOM build-up may be limited. The study was conducted in a split field experiment where one half was managed with the farmer’s current methods (control) and the other half was managed with winter cover crop and minimum tillage (treatment) for a period of three years. All fields in the study were in a corn (*Zea mays* L.)-soybean [*Glycine max* (L.) Merr.] rotational cropping systems in northwest Mississippi. To monitor the change of the soil chemistry over the study period, soil sampling of cores representing 0-15 cm soil depth was repeated in the same location and in the same period of the year (spring) for each year of the study. Although significant differences in interaction between treatment and year were detected for most macronutrient and base saturations of cations, the only significant treatment difference was observed for iron. Most micronutrients were significant only for year. These findings likely result from a combination of factors that did not promote SOM accumulation and accordingly the expected follow-on benefits to soil health. Findings suggest that growers adopting cover crops and minimum tillage should not expect to significantly increase SOM or decrease fertilizer rates during the early stages of the transition to a conservation system.

Subject: Water Resource Assessment and Management

Location: Room 317 on Main Level

Time: 10:30 AM - 12:00 PM

Paired Small Watersheds Assess Conservation Efforts with Producer Input

Authors: *Gary Feyereisen (ARS-USDA)*; Nathan Carr (Faribault County SWCD); Merissa Lore (Faribault County Drainage Department); Brent Dalzell (USDA-ARS)*

Stakeholders with interest in water quality outcomes from agricultural watersheds have voiced needs for increased monitoring of watersheds, assessment of conservation practice effectiveness at this scale—including stacking of practices, and involvement of practitioners in conservation efforts. This study is designed to evaluate conservation efforts in a corn-soybean production system by a paired watershed approach. Hydrology and water quality of adjacent 600+ acre watersheds in Faribault County, Minnesota, are in the third year of measurement. The sizes of the watersheds are strategic: large enough to incorporate landscape features, e.g., field edges, road ditches, and wetlands, yet small enough to apply conservation practices to a high percentage of the cropped area. To date, regression relationships between the watersheds of bi-weekly flow (R^2=0.97) and nitrate-N load (R^2=0.94) are good. Local conservation professionals, producers in the watersheds, and researchers are establishing a plan to deploy conservation practices on one of the watersheds to assess impacts. Discharge at the outlet of one of the watersheds is treated by a large, multi-bed bioreactor system, offering the potential to evaluate the stacking of conservation practices. Additional research at/near the site includes assessment of surface/subsurface flow separation, field validation of the Agricultural Conservation Planning Framework, ties to efforts to improve drainage modeling routines in SWAT+, and performance assessment of a unique dual-lateral saturated buffer design. This research benefits science and society by providing a real-world scientific assessment of conservation efforts with co-learning between researchers and producers.

Sediments and Nutrients of the Lower Des Moines River Delta at Red Rock Reservoir, Iowa

Authors: *Matthew Streeter (University of Iowa)*; Keith Schilling (Iowa Geological Survey); Thomas Stoeffler (University of Iowa); Elliot Anderson (University of Iowa); Antonio Arenas (Iowa State University)*

In Iowa, there are nearly 4,000 state-regulated reservoirs of varying scales that have been created for ecological management and water use. This includes more than 20 major reservoirs that hold at least 6.2 million m^3 of water. While not all of these reservoirs are fed by major rivers, sedimentation resulting in delta formation occurs at varying rates in all of them. However, characterization of the sediments residing in these deltas has not been completed. Our study provides geomorphological characteristics of the top 1.2 m of sediment residing in the lower Des Moines River delta at Red Rock Reservoir that was obtained during a field campaign in the fall of 2021 and corresponding desktop investigation. We discuss the implications of the lower delta sediment and topographic characteristics in terms of sediment and nutrient storage and the potential impact that this environment may have on other ecologically important topics like water quality.

Watershed-Scale Feasibility Assessment for Drainage Water Recycling Implementation

Authors: *Spencer Pech (ISG)*; Chris Hay (Iowa Soybean Association)*

Drainage water recycling (DWR) is an emerging practice where subsurface and surface drainage water is captured and stored for reuse as supplemental irrigation during dry periods. DWR has demonstrated increased

resiliency to excess and deficit water conditions and nutrient load reduction from drained cropland by capturing and reusing drainage water that would otherwise be discharged downstream.

Iowa Soybean Association and ISG are partnering to identify and map potential DWR sites across four watersheds in Iowa. Potential DWR sites were evaluated using GIS tools and methodology, reviewing of existing watershed plans and reports, and tapping into local knowledge from existing relationships. GIS data identified sites with soil and topography suitable to water storage and irrigation as well as existing drainage infrastructure. Potential sites were prioritized based on alignment with GIS criteria, location in priority watersheds, and potential landowner interest. The assessment identified 503 potential sites with up to 55,777 hectares (137,829 acres) suitable for DWR within the four watersheds.

Results from the Agricultural Conservation Planning Framework (ACPF), which identifies sites for other edge-of-field practices (wetlands, saturated buffers, and bioreactors), were integrated into the assessment to provide options to landowners. The watershed-scale assessment results will be used for landowner outreach, interest generation in priority watersheds, and to support funding proposals to implement projects.

A well-sited DWR project can provide agronomic benefits to the individual producer, drainage benefits to neighboring lands, and water quality benefits to downstream waters. DWR has the potential to transform crop production on drained lands, creating cropping systems that are more resilient to climate risks and promote long-term sustainability.

Subject: Climate-Smart Agriculture

Location: Room 313 on Main Level

Time: 1:30 PM - 3:00 PM

Grass to Gas: Stakeholder Perspectives on the Development of a Hypothetical On-Farm Perennial Grass-Based RNG Production Value Chain

Authors: *Chris Morris (Iowa State University)**

There has been a recent substantial increase in media coverage and political debate regarding the potential consequences of on-farm production of renewable natural gas (RNG) as a climate-smart fuel. RNG is chemically identical to methane (natural gas) and can be produced through anaerobic digestion using biomass as a feedstock. In the agricultural sector, some farms are experimenting with installing anaerobic digester (AD) systems that convert livestock manure and/or harvested crop biomass into RNG and digestate co-products that can be used as soil amendments. The RNG could then either be used on-farm for heat or electricity generation or injected into the existing natural gas infrastructure and sold for municipal use. This research project examined a proposed AD system that would use perennial crops, cover crops, and other soil-building crops as the primary feedstocks for RNG production. Widespread use of AD systems that use perennial crops and cover crops as the primary feedstock could have significant and far-reaching impacts on soil and water conservation, the economic vitality of rural communities, and climate change mitigation. Therefore, it is critical to examine the intended and unintended consequences and implications of this emerging technology to inform its development. To better understand these factors, social scientists from Iowa State University and Penn State University conducted a series of in-depth interviews with state and national stakeholder groups who would be engaged in this hypothetical value chain. Interview data were analyzed using a responsible innovation framework. Stakeholder perspectives on potential positive and negative consequences of this value chain will be presented, and implications for agricultural conservation and climate change policy will be discussed.

Save Farmland, Protect the Climate: Case Study of Avoided Emissions from an Agricultural Conservation Easement in Central Illinois

Authors: *Bonnie McGill (American Farmland Trust)*; Rachel Seman-Varner (American Farmland Trust); Ryan Murphy (American Farmland Trust); Ann Sorensen (American Farmland Trust); Shradha Shrestha (American Farmland Trust); Theresa Nogeire-McRae (American Farmland Trust); Emy Brawley (The Conservation Fund); Mitch Hunter (University of Minnesota); Bianca Moebius-Clune (American Farmland Trust)*

Between 2001 and 2016, 11 million acres of US agricultural land were lost to urban and low-density residential land use. Farmland converted to residential use in low-density or rural areas tends to be more energy intensive per household than smart growth urban development. Thus, agricultural conservation easements that are part of a buffer zone supporting in-fill of already developed areas, protect the land that sustains us and help avoid the excess greenhouse gas emissions associated with low-density residential development. Calculating the climate benefit from agricultural conservation easements on farmlands at risk of development could help land trusts and communities communicate their climate impact and apply for climate mitigation funding for more easements. The California Air Resources Board has developed a methodology to estimate the greenhouse gas mitigation benefits of protecting agricultural land. The methodology assumes that protecting farms on the urban fringe will result in more compact development without reducing the number of housing units built. We adapted this methodology to estimate the greenhouse gas benefits of an agricultural conservation easement on a 103-acre farm in East Peoria, Illinois. We estimated that the easement on this farm in central Illinois potentially

avoids over 19,000 metric tonnes of carbon dioxide equivalents in its first 30 years, the equivalent of over 100 railcars' worth of coal burned. This estimate demonstrates the potential climate benefits of protection of certain farmlands. We will also provide insights into our on-going work to develop an avoided emissions calculator tool for protected farmlands anywhere in the contiguous US.

Smart Solar Siting—Agrivoltaics in the Midwest

Authors: *Joel A. Tatum (American Farmland Trust)**

The United States is experiencing two simultaneous crises: farmland loss and climate change and its impacts on agriculture. With a large percentage of a generation preparing or actively retiring, the U.S. is experiencing the largest land transfer in history. Farmland is most vulnerable to permanent development when passed between generations. AFT is aware and seeking to mitigate land use impacts while attempting to meet the goals and needs of states in the clean energy transition in the Midwest. Solar is an optimal and expeditious means to meeting clean energy goals in most states because it can be quickly deployed and oftentimes, provides benefits to farmers, businesses, communities, and other groups. The easiest and most cost-effective way to deploy solar is often on flat, often productive, farmland located near an efficient interconnection point. Although conventional community solar and other solar project types are a temporary 20-40 year change of land use, there is tremendous opportunity to proactively and holistically pair agricultural production and responsible solar site development. Agrivoltaics (AV) has been studied around the world, but solar developers and policy makers in the Midwest remain skeptical because the designs and scale of the projects are cost prohibitive, there is a lack of widespread, accepted knowledge of solar plus farming operations, concerns around project financing, and a general deficit of research. Agrivoltaics present a possible solution that has drawn interest from the solar industry and agricultural community; however, more research is needed on the potential impacts of AV – technically, economically, and socially. This presentation will give an overview of AFT's role in Smart Solar Siting and how partners can meet renewable energy goals without taking large amounts of valuable farmland out of production.

When to Turn on the Water? The Effects of Irrigation Strategies in Mixed Vegetables in the Northeast

Authors: *Rachel Schattman (University of Maine)*; Tsutomo Ohno (University of Maine); Joshua Faulkner (University of Vermont); Rebecca Maden (University of Vermont); Haley Jean (University of Maine)*

Many Northeast growers are interesting in refining their irrigation scheduling approach, but many do not have experience with the soil moisture sensing approaches currently on the market. More commonly, vegetable and small fruit farmers in the Northeast used observable crop condition and the tactile dryness of soil to determine when to initiate and desist irrigation. We present initial findings that farmer willingness to invest in soil moisture sensors and software increases as potential yield gain also increases. Additionally, we conducted field experiments in Maine and Vermont, U.S.A. for two growing seasons to investigate how using the feel method, soil moisture sensors, and timers to schedule irrigation affects soil moisture levels, leaching, and crop yield and quality. Although our findings show no significant effects of scheduling method on yield of the vegetable crops, there are clear advantages to the use of soil moisture sensors. The use of sensor increased the proportion of days during the growing season in the optimal field capacity range. Additionally, sensors resulted in less irrigation applied compared to the feel method in three of the four field studies. Nitrate leaching, especially sandy textured soils, is a concern with potential to contaminate groundwater sources and is a direct economic cost as N is lost for crop uptake. The depletion of extractable soil N occurred to the greatest extent for the timer

method and the least extent with the sensor method suggesting that over-irrigation may lead to the loss of N from the rooting soil zone. Overall, the results from these field studies show that the use of soil moisture sensors to initiate irrigation will result in soils having optimal soil moisture levels on more days and reduce potential environmental risk associated with N contamination of groundwater sources. These findings will be useful to agricultural advisors who work with farmers on irrigation scheduling in diversified production systems.

Subject: Conservation in Organic, Specialty, Small-Scale, or Urban Agriculture

Location: Room 314 on Main Level

Time: 1:30 PM - 3:00 PM

A Whole-Systems Approach to Reducing Tillage in Organic Farming for Sustainable Grain Production

Authors: *Ravi Teja K.R. Neelipally (University of Tennessee)*; Debasish Saha (University of Tennessee); Shawn Hawkins (University of Tennessee); Song Cui (Middle Tennessee State University); Sindhu Jagadamma (University of Tennessee)*

Organic farmers rely heavily on tillage as a chemical-free alternative to control weeds, pests, and diseases, as well as increase the availability of nutrients in the soil. However, intensive tillage has had detrimental environmental repercussions, contradicting organic farming's commitment to promoting sustainability. More eco-friendly organic management methods are needed due to rising awareness and demand for sustainable organic products. We investigate reduced tillage techniques in organic grain production to improve soil health and productivity. In Fall 2020, two field experiments were initiated on certified organic land at the East Tennessee Research and Education Center of the University of Tennessee in Knoxville, Tennessee, and the Experimental Learning and Research Center of Middle Tennessee State University in Lascassas, Tennessee. Three-year rotations of soybean, wheat-soybean double-crop, and corn were established to achieve one of four objectives: maximize grain production, maximize grain production with reduced tillage, maximize ecosystem services, and enhance ecosystem services while excluding external nutrient inputs. Crops are grown in a full-entry design, and cover crops and poultry litter supply plant nutrients. Preliminary results showed that reduced tillage, depending on its intensity, can effectively sequester 1.5 to 2 Mg carbon ha^{-1} $year^{-1}$. Cover crop biomass ranged between 5-8 Mg ha^{-1}, and corn, soybean, and wheat yields ranged between 5-6 Mg ha^{-1}, 2-4 Mg ha^{-1}, and 2-4 Mg ha^{-1}, respectively. Our study supports ecologically responsible practices in organic farming and sheds light on the impact of management techniques on soil carbon and nutrient availability. However, further research is required to ensure the long-term sustainability of reduced tillage organic grain systems. This entails developing suitable crop varieties, determining optimal seeding rates, managing weeds, pests, and diseases, and planting in dense residue conditions.

Assessing and Managing Urban Soil Health: Tools and Training from USDA NRCS

Authors: *Joshua Beniston (U.S.D.A. NRCS, Soil Health Division)**

Urban agriculture offers many potential benefits to communities and participation in urban agriculture is robust across U.S. cities. Urban agriculture, Equity, and Climate Smart Agriculture are agency priorities for the USDA Natural Resources Conservation Service (NRCS). These priorities are driving an expansion of NRCS conservation work in urban areas. Urban land presents unique conditions for conservation management, including soils that vary from sites with robust soil health to those with severe degradation. The small-scale of urban sites also presents opportunities for applying management practices to improve soil health and ecosystem services. Applying conservation to urban land requires adaptation of our information and tools. The NRCS Soil Health Division has developed a package of educational resources and curriculum to provide improved understanding and management of soil health in urban areas. We have published three technical notes focused on urban soil health: (1) Basics of urban soil health, (2) Site evaluation and testing for urban soils, and (3) Conservation practices for managing urban soil health. These short publications provide information and additional resources on basic soil science, soil testing and the management of urban soils. The information is drawn from current published research, advances in urban soil survey, and the experience of urban conservationists. We have also

developed workshops that present this information through both classroom and field training. This presentation will provide a detailed description of these publications and curriculum. These tools will be a resource to conservation professionals and land managers working in urban areas.

Utilizing Sustainability Initiatives as Models for Urban Soil Restoration

Authors: *David Dechant (Arborguard (A Davey Tree Expert Company))**

Urban soils pose significant challenges to healthy plant growth. They are often severely compacted, contain little or no organic matter, may contain chemical contamination or the soils characteristics themselves may be toxic to plant growth. Soil conservation is a component of sustainability initiatives such as ENVISION and Sustainable Sites (SITES). These initiatives have specific requirements for the restoration of severely disturbed soils to promote healthy plant growth. A variety of soil restoration techniques including the "Scoop and Dump" method of soil decompaction, contaminated soil removal and replacement, and the incorporation of organic matter into the soil profile will be presented. The benefits of adding soil amendments such as Biochar, composted wood waste and the usage of structural soils in soil profiles will be discussed. Examples will be provided demonstrating the techniques and use of these materials for the rebuilding of disturbed soil profiles on active construction sites. These techniques can also be applied to smaller landscape or urban agriculture projects. Strategies on how soil profile rebuilding specifications are incorporated into the construction document set and implemented in the field will be given.

Subject: Conservation Models, Tools, and Technologies

Location: Room 315 on Main Level

Time: 1:30 PM - 3:00 PM

A Geospatial Tool for Identifying Marginal Land and Assessing the Ecosystem Services of Perennial Bioenergy Crops

Authors: *John Quinn (Argonne National Lab)*; Julian Cacho (Argonne National Laboratory); Andrew Ayers (Argonne National Lab); Cristina Negri (Argonne National Lab); Bradford Kasberg (Argonne National Lab); James Kuiper (Argonne National Lab); Colleen Zumpf (Argonne National Laboratory); Nora Grasse (Argonne National Lab)*

Perennial bioenergy crops can serve as a source of biomass to support the bioeconomy. The integration of these crops on the agricultural landscape can be accomplished in a way that avoids land use change by targeting economically and/or environmentally marginal farmland. We are developing an online geospatial tool to assist in decision-making for the adoption of perennials. The Scaling Up Perennial Bioenergy Economics and Ecosystem Services Tool (SUPERBEEST) identifies marginal land based on a combination of NCCPI, SSURGO, and USGS information. It also indicates candidate sites for saturated bioenergy buffers. Other capabilities under development include a determination of a range of important ecosystem services provided by perennials and an estimate of the net economic value of a change from row crops. SUPERBEEST can be used at any scale, from field or subfield to one or more watersheds or counties, by farmers, landowners, researchers, agencies, or biorefinery industry planners.

Consideration of Restored Floodplain Easements in the Agricultural Conservation Planning Framework (ACPF) and the Financial and Nutrient Reduction Tool (FiNRT)

Authors: *Kelsey D. Karnish (Iowa State University)*

Non-point source nitrogen and phosphorus pollution from agricultural landscapes has negatively impacted water quality across the United States. Conservation practices, including restored floodplains, have been shown to mitigate negative water quality impacts – yet, where to prioritize placement to maximize environmental outcomes and financial resources remains unclear. This research leveraged publicly available data and geospatial tools associated with the Agricultural Conservation Planning Framework (ACPF) to create a new tool for an additional BMP, restored floodplain easements, in the suite of ACPF BMP tools to assist natural resource practitioners in locating and prioritizing suitable potential floodplain easements for restoration to enhance water quality and applied the methodology in two case study watersheds. The key data layers and criteria include proportion of field within the 2-, 5-, and 10-year floodplain, field boundaries, and land use characteristics to align with NRCS practice standards. The tool identified 421 possible easement locations in two adjacent case study watersheds at the HUC 12 scale, which represent a total area of 30,537 acres (74% of watershed area). Of the fields suitable for floodplain easement, approximately 1,200 acres (3% of watershed area) were identified as very high priority and 4,200 acres (10% of watershed area) were identified as high priority based on the frequency of inundation of the fields. Because of direct and opportunity costs associated with restoring floodplain easements, we updated the ACPF Financial and Nutrient Reduction Tool to integrate information on estimated costs and nitrate reduction outcomes associated with restored floodplain easements. This tool assists natural resource practitioners and conservation planners in identifying and prioritizing potential floodplain easement locations and can be applied across the state of Iowa and in other regions where data exists to improve water quality for citizens.

Iowa Food-Energy-Water Nexus (IFEWs) - A Visualization Tool and Model for Decision-Making

Authors: *Júlia Brittes Tuthil (Iowa State University)**

Due to Iowa's significance in agriculture and its contribution to the long-term nitrate load in the Mississippi-Atchafalaya Basin (between 11 and 52% of nitrate load added), it is important to define and comprehend the relationship between nutrient pollution and agricultural production. Existing hydrological and water quality models are able to quantify nutrient pollution. Iowa's food, energy, and water subsystems (IFEWs) are intricately intertwined. No models are currently available to account for all subsystems and their interconnections in a rainfed state like Iowa. We are creating a straightforward but extensive FEW (Food, Energy, and Water nexus) model for the state of Iowa as well as a visualization tool to show how the subsystems interact and vary in space and time. The model links the components of the FEW systems using relationships found in the literature and includes a geodatabase of openly accessible data. To depict the historical data and model outputs on a county-by-county basis across Iowa, the data visualization tool makes use of geographic information systems and cutting-edge data visualization. The Iowa Nutrient Reduction Strategy is the basis for the current development, which allows for the visualization of nitrogen conservation strategies and represents potential nutrient and agricultural product outcomes. With stakeholders, including researchers, farmers, and policymakers, the tool and model aims to provide decision assistance through analysis, visualization, and evaluation of the IFEWs.

Modeling to Protect Downstream Waters: Tools and Technologies for Better Designs

Authors: *Bailey Griffin (ISG)*; Chuck Brandel (ISG)*

As an industry leader in water resource management, ISG's team uses leading-edge technologies to optimize designs and protect natural resources. Modeling, drone, and pipe camera technologies are used to capture accurate data and improve designs that are based on project and stakeholder goals. ISG will present noteworthy case studies that explore how a variety of targeted technologies can be applied to collect data that support multi-purpose drainage management. The case studies detail real-world challenges, and the design solutions developed using innovative technologies. We will highlight projects that have benefited from one- and two-dimensional hydraulic modeling with XPSWMM and ICM software to deliver solutions that increased productivity while protecting downstream waters. In addition, the presentation will showcase how drones are used to capture water on landscapes, including flood events, LiDAR drones to capture ground elevations, and pipe cameras to televise existing tile conditions to determine whether pipes are providing adequate support or require repairs. ISG’s project management and applied technology teams determine the best technology combination for each project. Using highly accurate and detailed data sets allows engineers to develop optimal designs for clients. These data-based deliverables identify opportunities and provide landowners and stakeholders with the information needed to achieve project goals.

Subject: Soil Health Resources, Indicators, Assessment, and Management

Location: Room 316 on Main Level

Time: 1:30 PM - 3:00 PM

Linking Soil Health Assessment to Edge-of-Field Water Quality in the Great Lakes Basin

Authors: *Molly Meyers (UW-Green Bay)*; Luke Loken (USGS); Matt Komiskey (USGS); Kevin Fermanich (UW-Green Bay); Marianne Bischoff Gray (Purdue University); Ronald Turco (Purdue University); Karen Stahlheber (UW-Green Bay); Mathew Dornbush (University of Wisconsin Green Bay); Lisa Duriancik (USDA-NRCS)*

As farms and conservation professionals strive to implement conservation practices to build soil health and improve water quality, there is a need to understand how changes in soil health impact the water quality leaving the field. To better understand factors driving agricultural nutrient losses, we evaluated relationships between farm management (e.g., manure and tillage), soil health measurements, and resulting edge-of-field (EOF) surface water quality. We utilize data collected from 14 EOF sites spanning Wisconsin, Michigan, Indiana, Ohio, and New York during a period prior to or early in conservation practice establishment to: 1) characterize soil health indicators across GLRI EOF sites, 2) assess relationships among soil health indicators, EOF catchment factors, and surface runoff quantity and quality, and 3) identify challenges to linking in-field soil health to water quality. This presentation will give an overview of the results published in “Challenges in Linking Soil Health to Edge-of-Field Water Quality” (Fermanich et al., 2022). While our study was limited in the number of sites, cropping systems, and site-years, it does show strong linkages between soil nutrient levels, soil organic C, soil microbial properties and EOF surface water quality. Specifically, fields with favorable soil organic C and microbial soil health indicators can be linked to undesirable water quality exports, especially in fields enriched with animal manure. A desirable soil health signal on EOF surface water quality (i.e., improved infiltration, water holding capacity, water stable aggregates, nutrient security) might be more discernable in fields without crop production-excess nutrients or nutrient management practices (e.g., surface applied fertilizer or manures) that lead to high runoff potential. Beyond exploring the baseline results, the presentation will include subsequent years of soil and water data with updated results and analysis.

Soil Health Assessment in Double-Cropping Wheat Systems across Texas

Authors: *Hector L. Valencia (Texas A&M Agrilife)*; Katie Lewis (Texas A&M Agrilife); Jamie Foster (Texas A&M AgriLife)*

Conventional management of agricultural systems can threaten soil health by contributing to soil erosion, soil carbon loss, and inefficient water use in crop production. Cover crops and conservation tillage have been reported to improve soil health, but the additional planting and maintenance comes at an additional cost. Double-cropping systems have the potential to mitigate that cost by providing producers a secondary crop with an additional source of income while providing soil health benefits. Management decisions can directly or indirectly influence soil physical, chemical, and biological properties related to soil health. This project evaluated double-cropping wheat systems and tillage practices across 3 study locations in Texas: Texas A&M AgriLife Research in Lubbock, Stiles Farm Foundation in Thrall, and Texas A&M AgriLife Research in Beeville. Tillage treatments included: 1) conventional tillage (disk plow), 2) strip-till, and 3) no-till. Cropping treatments included: 1) wheat-sorghum, 2) wheat-sesame, 3) wheat-cowpea, 4) wheat-cover crop mix, and 5) wheat-summer fallow. Expectations are to see greater response to soil health indicators in study plots that incorporated yearlong cover with a grain crop or a cover crop and no-till compared to a wheat-fallow and conventional tillage system. Results will help to identify conservation management practices, specifically double-cropping, that can help provide

additional economic value to producers while providing data on maintaining or improving the health of soil systems.

Soil Health Interpretation Portal (SHIP): An Expandable, Exploratory Database to Compare Management Practice Influence on Iowa's Regional Soil Health

Authors: *Suzanne Fey (Iowa Soybean Association)*; Josh McDanel (Iowa Soybean Association)*

How does soil health testing differ from soil fertility testing? To what extent does regional and glacial history determine differences in modern agricultural soils? Can we benchmark and track progress on Iowa's overall soil health? Are there tests that can measure the agricultural performance of our soils relative to their optimal capacity?

The Iowa Soybean Association has compiled a benchmark database of soil health and soil fertility test results. The Soil Health Interpretation Portal (SHIP) initial benchmark database is an anonymous conglomeration of lab results from soil health studies conducted by ISA in conjunction with results from Iowa Corn Growers collaborative multi-year Soil Health Partnership program. Statewide results of ISA's 2011 Nutrient Benchmarking program are also included as part of the standard soil test background dataset, giving visitors a snapshot of soil metrics from a decade ago. Users can anonymously donate their georeferenced soil test data to expand the secure dataset and receive a report of "Soil Health Assessment Protocol and Evaluation" or "SHAPE" scores for each sample location with no requirement to donate their data. These values are computed using 30-year average weather and underlying soil structure and texture data extracted from georeferenced data layers stored in the portal to compute a score of how well each sample area is functioning compared to its full potential. Through the "Quick Look" feature, visitors can explore the benchmark databases. The tool provides opportunities to compare different combinations of manure, tillage, and cover crop management practices on test results summarized by physiographic subregions with similar topography and soil structure. There are also explanations of the basic soil health metrics being tracked in the portal. Subregions are identified on an interactive map with links to descriptions of soil history and composition. The portal is available here: https://shportal.iasoybeans.com

USDA-NRCS In-Field Forest Soil Health Assessment

Authors: *Joe Williams (USDA-NRCS)*; Laura Starr (USDA-NRCS); Tom Sauer (USDA-NRCS)*

Forests and woodlands comprise over a third of the nation's land and contribute $200 billion in products to the United States economy each year. In addition to forest products, healthy forestlands provide critical ecosystem services to the landscape such as clean water, carbon storage, slope stabilization, wildlife habitat, and recreation opportunities. Forest soil health is a critical component to sustaining these important ecosystem services, yet few tools are available to land managers to assess the health of their soil. Although a Cropland Infield Soil Health Assessment has been successful with producers and planners for several years, the assessment is not suitable for forest soils. The NRCS, with technical assistance and input from the US Forest Service, has developed a Forest In-field Soil Health Assessment (FIFSHA) to provide a rapid, qualitative assessment. The objective of this work is to facilitate identification of resource concerns such as aggregate instability, compaction, and erosion in forest soils. The FIFSHA indicators are organized by their relationship to the four soil health principles, maximize soil cover, minimize disturbance, maximize diversity, and maximize living roots. The indicators include a visual assessment of soil cover, woody debris, canopy cover, root presence and distribution, and plant community. Our

goal is to provide a forest soil focused tool to facilitate the optimal management of forest systems and access to NRCS programs that promote conservation

Subject: Water Resource Assessment and Management

Location: Room 317 on Main Level

Time: 1:30 PM - 3:00 PM

Lessons, Challenges, and Barriers – Advancing the National Nonpoint Source CWA §319 Program to Address Advancing Equity, Climate Change

Authors: *Cyd Curtis (US EPA)**

Under §319 of the Clean Water Act, EPA awards grants to states, territories, and tribes to manage nonpoint source polluted runoff programs and implement local projects to restore and protect water quality. The bulk of NPS activities rely on voluntary program participation, interagency cooperation, and partnerships. To date NPS efforts have documented water quality improvements including 11,400 miles of rivers and streams and 172,000 acres of lakes and other waters. Funded activities and projects must meet EPA requirements, described in the §319 Nonpoint Source Program and Grants Guidelines for States and Territories (guidelines) for. The guidelines highlight requirements from the CWA, the code of federal regulations and EPA priorities for funding. In 2022 EPA held a series of listening sessions and workgroups with grantees to better understand challenges and barriers to increasing equity in the NPS program. From that input, in 2023 EPA is doing a comprehensive effort to revise and update the 2013 guidelines to better integrate equity and climate resilience within the NPS program. This presentation will provide an overview of key barriers identified through listening sessions and the draft proposed updates to the guidelines. The presentation will include expectations for 9-element watershed plans, long-term monitoring, and addressing emerging challenges from climate change impacts on local watersheds.

(At the time of the conference, EPA anticipates having a draft version of the guidelines available for public comment.)

Market District: A Public-Private Partnership to Design and Construct One of the Largest Green Infrastructure Neighborhoods in the Midwest

Authors: *Craig Clarkson (ISG)**

Under development as the future site of a growing mixed-used neighborhood, the Market District in downtown Des Moines represents another step forward into the City's bright future. The 12 square block area was a formal industrial hub known for flooding issues but is quickly turning into a model for sustainability with water quality as its bedrock. The Market District will treat runoff from private lots and public right-of-way using distributive green infrastructure. In total, 82 bioretention cells line the parkway accepting and treating over a million gallons of water on a given rain event. This presentation will focus on the importance of public-private partnerships to push large-scale green infrastructure projects forward—paving a way for bold urban water management solutions.

Private and Collective Agricultural Returns on Drainage Investments in Upper Midwest

Authors: *Rwit Chakravorty (Iowa State University)**

This paper seeks to understand the private crop productivity returns to investments in tile drainage, and the benefits of cooperation and coordination among farmers to drain land in their watershed. Being flat and wet, crop productivity on a large fraction of upper Midwest land improves markedly when drained. Looking forward,

the Upper Midwest is expected to become wetter (Tack et al. 2018). The drainage investment is costly. Effective drainage typically requires cooperation among several farmers operating in a watershed, where failure to cooperate on collectively supported assets (main drains) will lead to suboptimal returns on own-field investments. Thus, there is no guarantee profit-maximizing farmers will invest at levels consistent with maximizing sector profitability. An understanding of actual investment choices is essential for comprehending the potential scale of environmental impacts arising from these investments. This paper includes: 1.Yield Response: The empirical exercise will estimate the marginal effect of one additional acre of tile drainage on the yield distribution (mean, variance, skewness) of corn and soybean crops across the Upper Midwest 2.Climate Assessment: Controls used in our analyses will account for technology through time trends, for topography, and also for weather variables. In addition to acting as controls, the weather variables will be used to scrutinize how climate change will affect investment incentives 3. Profitability: Discounted present value and related tools are used to establish profit implications of these investments, and so ascertain what levels of drainage will maximize sector profit in a given region. 4.Hotspot Assessment: The econometric model will also allow for a better understanding of regional trends in drainage investments. The intent here is to help improve the quality of discussions and any policy choices that may arise from government and administrative responses to the ongoing wave of drainage investments.

The Great Rivers Ecological Observatory Network (GREON): Lessons Learned from the First 10 Years of Automated Water Quality Monitoring

Authors: *John J. Sloan (National Great Rivers Research and Education Center)*; Miles Corcoran (OTT HydroMet); Ted Kratschmer (Northwater Consulting); Jennifer Hemphill (National Great Rivers Research and Education Center); Jessica Mohlman (National Great Rivers Research and Education Center); Melissa Schindler (National Great Rivers Research and Education Center)*

The National Great Rivers Research and Education Center (NGRREC) initiated a continuous water quality monitoring effort in 2013 called the Great Rivers Ecological Observatory Network (GREON™). The foundation of the network was a fleet of floating platforms that housed the sensors, electronics, communications, and solar power array that allowed each unit to continuously monitor water quality and to transmit the data offsite using a cellular modem. Each GREON unit collect the following water quality parameters: Temperature, specific conductance, turbidity, dissolved oxygen, Total chlorophyll, cyano bacteria, and fluorescing dissolve organic matter (fDOM). Data from the GREON units was regularly retrieved and stored on the Great Lakes to Gulf Virtual Observatory (GLTGVO). The original intent was to deploy the GREON units along the main channel of the Mississippi River and in backwater lakes. This presentation will discuss the lessons learned regarding the deployment of free-floating water quality monitoring platforms in lotic systems. Specific deployment sites will be discussed including how water quality data form the units has been used. The project is currently undergoing transition into a second phase that will be based on lessons learned from the first 10 years of deployment.

Subject: Conservation Economics and Policy

Location: Room 314 on Main Level

Time: 3:30 PM - 5:00 PM

Alternative Farming Systems to Maintain Profitability while Reducing Nitrogen and GHG Emissions

Authors: *Mohammad Khakbazan (Agriculture and Agri-Food Canada)*; Ramona Mohr (Agriculture and Agri-Food Canada); Kui Liu (Agriculture and Agri-Food Canada)*

Canada's national inventory report of greenhouse gas (GHG) emissions indicates that the agriculture sector accounted for 75% of N_2O emissions in 2020, mainly by the application of inorganic nitrogen (N) to cropland in the Canadian Prairies. Since 2005, N application has increased by 89% while N_2O emissions increased by 92%. It is critical that we identify the most sustainable agricultural practices, specifically those that increase profitability and reduce environmental impacts such as GHG emissions. This study compare multiple crop rotations that include N-fixing crops and enhanced-efficiency N fertilizer (EEF) in order to identify system(s) that optimize economic returns while reducing inorganic N application. Five 4-year crop rotations conducted from 2018-2022 in four locations in western Canada evaluated the effects of rotating cereal or oilseed crops with a range of N-fixing crops on the economic returns and N use of the crop rotation systems. An additional experiment was established that compared the relative performance of application of SuperU, an EEF, to a conventional N fertilizer application. Treatments were arranged in a randomized complete block design with four replicates. Net revenue (NR) and N application rate were the response variables used in ANOVA and regression analysis to compare the effectiveness of multiple crop rotations and different fertilizer sources. The results indicated that the canola-wheat rotation performed similarly to a diverse rotation including peas and faba beans alongside winter wheat or malt barley. The diverse rotation, however, used 51% less nitrogen. Application of EEF increased canola yield by 10% and reduced N use by 9% compared to the conventional urea application. These results indicate that N use, and therefore nitrous oxide emissions, may be reduced while maintaining profitability through growing more N-fixing crops in rotation and, under some conditions, through the use of EEF in place of conventional N fertilizer.

Capturing the Full Value of Cover Crops

Authors: *Jeffrey Kappen (Baton Global)**

This paper shares a financial model built in cooperation with the Iowa Soybean Association and its partners to assess the holistic impact of a cover crop business accelerator across the state. This approach aims to capture not only the economic value of conservation practices on the land, through nutrient reduction and improved water quality, but also the additional value generated through increased business activity, job creation, and multiplier effects in local economies. Implications for the use of different incentive mechanisms e.g., direct acreage payments, equipment subsidies, etc. in coordination with prior grower experience will be discussed. Using three years of data from over 40 participants, the paper demonstrates how this model can be used to make the business case for farmers who are not yet participating in such programs. Feedback from accelerator participants about their experiences in the program and envisioned future refinements for education and outreach will also be shared for attendees who are interested in program design.

Conservation Pays: An Analysis of the Economic Benefits of Conservation Agriculture

Authors: *Jessica S. Jurcek (Minnesota Dept. of Ag); Brad Jordahl Redlin (Minnesota Department of Agriculture)**

As the push for protecting land and water through the agricultural industry grows, pressure increases to demonstrate that conservation farming practices yield positive economic outcomes. The Minnesota Agricultural Water Quality Certification Program (MAWQCP), AgCentric, and Minnesota State Agricultural Centers of Excellence are working to meet this demand and demonstrate the economic value of conservation agriculture. The MAWQCP is a voluntary opportunity for producers to assess and mitigate risks to water quality in their operations. Local certification specialists across Minnesota leverage technical and financial assistance to help producers implement the changes necessary to achieve certification and mitigate risks to water. The over 1,300 Minnesota producers who are Water Quality certified provide an opportunity to compare economic outcomes on farms embracing conservation practices to more traditionally managed operations. A subset of these farms participates in Minnesota's Farm Business Management (FBM) Program and makes their farm business data available. AgCentric and Minnesota State Agricultural Centers of Excellence started in 2019 to compare Water Quality certified producers to non-certified producers in the FBM program's FINBIN Database. The 12-state FINBIN database of annual farm financial records is nationally recognized and experiences over 40,000 users annually, making it a data-rich environment for economics in conservation practices. In the first three years of data comparisons, the Water Quality certified farms averaged 36 percent higher net income than non-MAWQCP-certified farms in the study group. The MAWQCP and partners will break down the results of this analysis and provide an example of using economic data to demonstrate the benefits of conservation agriculture for policy professionals, conservation planners, crop advisors, ag retailers, financial institutions, and anyone interested in quantifying economic improvement through conservation.

Modeling Growers' SNA Decisions and Evaluating the Economic and Environmental Outcomes of PACE

Authors: *Xuche Gong (Iowa State University)*; Hongli Feng; David Hennessy (Iowa State University)*

Studies have well documented that excessive nitrogen (N) fertilizer applications cause serious ecological and public health issues. Much research has been devoted to identifying strategies for more efficient N use. Policies and incentives have also been implemented, including the Post Application Coverage Endorsement (PACE) added to the federal crop insurance program in 2022. However, the success of these measures depends on a clear understanding of the operational and profit tradeoffs faced by farmers.

This study evaluates tradeoffs related to split N application (SNA) and models farmers' SNA decisions. Instead of applying all N in one pass during the fall or spring before planting, SNA applies some before planting and schedules the rest for throughout corn growth phases. By synchronizing N with corn uptake needs, SNA reduces N use and loss, saving N cost, and potentially increasing yields. However, unfavorable weather and field conditions may prevent post-planting N application, leading to reduced yields and profits. Fluctuating N prices and resource availabilities may also deter post-planting applications.

We model how farmers' SNA decisions vary with benefit and risk factors, and identify how the socially optimal SNA strategy diverges from the privately optimal N strategy. We then investigate how PACE can promote SNA adoption by indemnifying SNA adopters against financial loss when post-planting N application is prevented due to unfavorable weather conditions.

Our target audiences are the corn growers and policymaking and conservation communities that are interested in efficient nutrient management. By simulating with relevant data, our study will present context-dependent optimal SNA strategies with and without the risk management benefits that PACE can provide to SNA adopters.

It will also assist policymakers in evaluating the economic and environmental consequences of PACE, and suggest policy changes to promote the adoption of optimal SNA strategies.

Subject: Conservation Models, Tools, and Technologies

Location: Room 315 on Main Level

Time: 3:30 PM - 5:00 PM

In-Stream Bioremediation Filters and E. coli Reduction

Authors: *Amy Kay (City of Davenport)**

Fecal pollution is a common water quality issue in many waterways of the United States. Partners of Scott County Watersheds (PSCW), in conjunction with the City of Davenport, has strived to determine how to reduce e coli and hence fecal pollution concentrations within the Duck Creek watershed and other streams. A pilot project was initiated that involved placing strips of floating island materials and building “biofilters” within small streams. Robin Creek, located in west-central Davenport, was selected as the location for the biofilter installation. Fifteen e coli samples were collected for analysis over a two-year evaluation period. Upstream (untreated water) e coli sample results ranged from 57 to 17890 cfu/100 ml. Downstream samples ranged from 3 to 48840 cfu/100 ml. Twelve of the fifteen samples indicated a decrease in e coli concentrations, two showed increases, one sample indicated no change. Overall, the mean percentage reduction upstream to downstream over the evaluation period was 27.3%. Based on the measured total coliform and e coli data, there appears to be some influence on fecal bacteria by the biofilter assemblage.

Modeling Conservation Practice Water Quality Benefits in Lake Erie Watersheds to Support Adaptive Management

Authors: *Margaret M. Kalcic (University of Wisconsin-Madison)*; Anna Apostel (University of Wisconsin-Madison); Jay Martin (The Ohio State University); Kevin Czajkowski (University of Toledo); Kevin King (USDA-ARS); Asmita Murumkar (The Ohio State University); Kimberly Panozzo (University of Toledo); Ishfaq Rahman (University of Toledo); Vinayak Shedekar (The Ohio State University)*

The rise of eutrophication and water quality impairment across the United States and globally has driven state and federal government investments in programs aimed at reducing non-point source pollutant loading. In response to worsening Harmful Algal Blooms (HABs) in Lake Erie, state and federal governments are working to address agricultural sources of nutrient loads delivered to the lake. The state of Ohio has determined hydrologic models to be a key tool supporting an adaptive management approach that ensures policies and programs achieve water quality goals, in this case, the 40% reduction of total and dissolved phosphorus delivered from western Lake Erie watersheds. This work builds on previous efforts in the region utilizing the Soil and Water Assessment Tool (SWAT) to study the potential impacts of agricultural conservation practices on nutrient delivery to Lake Erie. We utilize state-of-the-art tools and data sources to pinpoint the locations of land management practices within the western Lake Erie watershed and to better represent farmland having elevated levels of phosphorus in soils. Our calibration and validation process utilizes instream, outlet-level data paired with a system of internal stream-gauges and field-level data. This improved calibration/validation approach improves model simulation of field-level management practices and processes. We are using the enhanced model to investigate impacts of management strategies through scenarios developed in concert with state agency personnel and a broad group of stakeholders broadly representing agricultural and environmental interests.

Terrain Index Estimation of Gully Head Location in the Midwest

Authors: *Brian Gelder (Iowa State University)*; Timothy Sklenar (Iowa State University); David Reece (University of Missouri); Richard Cruse (Iowa State University); Aleksey Y. Sheshukov (Kansas State University); Chunmei Wang (Northwestern University); Thomas Franti (University of Nebraska); John Lory (University of Missouri)*

Ephemeral gullies (EGs) are transitory concentrated flow erosion features, often re-filled with soil by annual tillage operations, that contribute significant sediment transport from agricultural fields. Predicting their potential location would be useful to guide land management decisions and for assessing their total contribution to soil erosion at regional levels. Terrain indexes have been used to identify EG head-cut locations, but they generally require calibration within each watershed where applied, limiting their use over broad scales. Grid Order is a relatively new terrain index that has shown promise in accurately locating gully head-cut location compared to four other terrain indexes: specific contributing drainage area (As), Compound Topographic Index (CTI), Stream Power Index (SPI), and a variation of Stream Power Index (AS2). To more fully analyze the indexes a dataset of over 2000 EG head locations in 76 HUC12 watersheds across 19 different landforms (Major Land Resource Areas) in Iowa, Kansas, Missouri, and Nebraska was compiled via visual analysis of digital imagery. Preliminary results in Iowa indicate that using As, CTI, SPI, and AS2 to identify flow length upstream from predicted EG head-cut locations would require careful calibration for each watershed or substantial errors in prediction accuracy would occur. However, using three-meter digital elevation models and a Grid Order value of four acceptable predictions of gully head-cut location were obtained without watershed specific calibration, returning Nash Sutcliffe Efficiencies in excess of 0.29 and locations within 20 meters of observed, even though Grid Order has more locational ambiguity than other metrics. Other environmental attributes (landuse, vegetation, pedology, weather, management) not related to terrain characteristics can be included in further studies to account for a more holistic approach in a gully prediction framework.

Using Big Data, Remote Sensing, and Computation to Improve the Efficiency of Conservation Area Identification

Authors: *James Zollweg (SUNY Brockport)*; Lydia Sweeney (SUNY Brockport)*

Accurate identification of key conservation areas in need of protection is a critical component of efforts to conserve valuable natural resources and biodiversity. Big Data, remote sensing, and computation (GIS, machine learning, etc.) provide an opportunity to identify these areas more quickly and extensively than field studies. “Boots on the ground” is the most accurate, detailed, and reliable survey method, BUT is also extremely time-consuming, costly, and logistically challenging. We propose that a tiered scoping/assessment process will be most effective.

The term Big Data refers to the current exponential growth of data and that data’s use. Numerous data sets applicable to conservation efforts are increasing in size, resolution, usability, and variety. Familiar examples are land use-land cover, SSURGO, building footprints, digital elevation models, hydrography, climate, demographics, and more. Additionally, remote sensing data (such as LiDAR, SAR, and satellite IR) has been increasing rapidly in recent years, both in scope and spatiotemporal resolution.

Fortunately, computing power and methodology have increased in tandem with data explosion. Together, emerging data resources and computing can characterize habitat, vegetation types, and landscape structure as well as impairments and threats. These characterizations can be used to guide conservation planning and management.

This methodology has been applied to floodplain forests. These are recognized as an imperiled community type in New York State but are not well mapped. This impedes efforts to address the threats and find areas for conservation or restoration action. Our results demonstrate that Big Data, remotely sensed data, and powerful computation can be used to effectively identify candidate areas for conservation, with the advantages of larger spatial coverage, and reduced data collection and processing time compared to field studies.

Subject: Edge-of-Field Practices and Monitoring

Location: Room 316 on Main Level

Time: 3:30 PM - 5:00 PM

A Decade of Saturated Buffer Research: Results from Long-Term Monitoring in Iowa

Authors: *Gabriel M. Johnson (Iowa State University)*; Thomas Isenhart (Iowa State University); Natalia Rogovska (USDA-ARS NLAE)*

Saturated buffers are an edge-of-field practice designed to remove nitrate-nitrogen from subsurface drainage systems to improve downstream water quality. These practices function by routing a fraction of the nitrate-laden drainage into riparian buffer soils to enhance natural denitrification and plant uptake processes. Research of these practices began in 2011 in Iowa resulting in more than 40 site-years of data. This study combines published data (2011-2017) with additional monitoring data (2018-2022) to provide novel assessments of long-term performance across sites and years. Methods include monitoring drainage flow with pressure transducers and calibrated weirs, and approximate biweekly grab sampling of drainage and buffer groundwater for nitrate concentration. Total mass load reduction was assessed as the difference in nitrate concentration from streamside wells (i.e., the "outlet" point) and the field drainage (i.e., the inlet point), multiplied by the total treated flow volume. At the time of abstract submission, across 31 site-years, the total nitrogen load reduction averaged 45% (sd: 26%) and ranged from 19 to 81% on average across four sites. Mass load of nitrogen removed normalized for contributing drainage area averaged 4.52 to 14.17 kg/ha across four sites. Additional expected results include full data across 40 site years, nitrate removal performance metrics normalized for saturated buffer length and interannual drainage variability, and assessment of temporal trends in performance. This study reinforces prevailing guidance that saturated buffers are highly effective at removing nitrogen from drainage waters and that optimal design and site selection are crucial to maximize nitrate mass removal. Future implementation efforts are recommended to prioritize high flow sites that can provide the highest cost efficiency ($/kg N) in water quality improvement.

Comparing Woodchips to Corncobs: A Pilot-Scale Denitrifying Bioreactor Study Evaluating Hydraulic Performance, Carbon Leaching, Nitrate Removal, and Costs

Authors: *Natasha L. Hoover (Iowa State University)*; Ji Yeow Law (Iowa State University); Alexis Slade (University of Iowa); Michelle Soupir (Iowa State University); Gary Feyereisen (ARS-USDA)*

Nine pilot-scale denitrifying woodchip bioreactors were installed at the Iowa State University Research Farm near Ames, IA in 2014. After 4 years of operation, six of the bioreactors were partially excavated at the inlet ends and refilled with corn cobs, with triplicate treatments; WC100 (maintained as original woodchip fill), CC25 (25% corn cobs with 75% original fill material), and CC75 (75% corn cobs and 25% original fill material). Hydraulic retention times (HRTs) of 2-h, 8-h, or 16-h were set for an individual bioreactor within each fill material/carbon treatment. This pilot-scale bioreactor project (2019-2022) aimed to investigate the use of corncobs as an alternative fill material. The research team evaluated and compared the hydraulic performance, carbon leaching, nitrate removal rate, and cost-efficiency. The hydraulic performances were evaluated using bromide tracer studies conducted in 2019 and 2022. In bioreactors with higher corncob (CC) contents, the research team observed higher volumetric efficiency, Morrill Dispersion Index, short-circuiting potential, and mean tracer HRT, but lower hydraulic efficiency. Total organic carbon (TOC) samples were collected periodically at each bioreactor inlet and outlet in 2020 and 2022 to evaluate the risks of increased carbon leaching with the more labile corncob fill material. The median outlet TOC concentrations (2020: 3.17 mg L^{-1} – 7.95 mg L^{-1}; 2022: 2.52 mg L^{-1} – 4.09 mg

L^{-1}) in each of the pilot-scale bioreactors were generally within the range of background steam concentrations in Iowa and showed no clear patterns between fill material and HRT treatments. Finally, weekly nitrate+nitrite (NO_x-N) samples were collected at each bioreactor inlet and outlet in 2019-2021. Overall, the NO_x-N removal efficiency (%) and rate (g N m^3 d^{-1}) increased with the amount of CC in a bioreactor. The N removal cost comparison for Iowa suggested that CC75 was the most cost-effective carbon treatment, followed by WC100 and CC25.

Effectiveness of Grass Buffer Strip in Reducing Surface and Subsurface Nutrient Losses from Agricultural Fields in Western Illinois

Authors: *Essam El-Naggar (Metropolitan Water Reclamation District of Greater Chicago)*; Olawale Oladeji (Metropolitan Water Reclamation District of Greater Chicago); Guanglong Tian (Metropolitan Water Reclamation District of Greater Chicago); Albert Cox (Metropolitan Water Reclamation District of Greater Chicago); Heng Zhang (Metropolitan Water Reclamation District of Greater Chicago); Ed Podczerwinski (Metropolitan Water Reclamation District of Greater Chicago)*

Quantitative information about the effectiveness of grass buffers at the watershed scale is necessary to guide decisions for implementing this practice. In this study, USEPA's paired watershed research approach was employed in two 10-acre fields located at the Metropolitan Water Reclamation District of Greater Chicago's site in Fulton County, IL. Surface runoff and nutrient loads from the two fields were monitored for a calibration period of three years (2016-2018). In 2019, an 18-m wide by-182 m long grass buffer strip treatment was established at the lower edge of one field (treatment field). Surface runoff nitrate and total P loads at grass buffer-treated and reference fields continued to be monitored. Subsurface nutrient loss was measured by installing Rhizon soil water samplers at 30 cm and 90 cm depths 15 m inside the crop area, and at 17 m, 12 m, 6 m, and 1 m from the lower edge of the buffer strip. Obtained results indicated that grass buffer reduced nitrate loads in surface runoff by 42.9 % and 99.0 % during 2020 and 2021, respectively, while total P loads in surface runoff were reduced by 16.2% and 29.7% during 2020 and 2021, respectively. The nitrate concentrations in the subsurface flow were reduced by 33%, 85%, 95%, and 97% for 1-m, 6-m, 12-m, and 17-m wide buffer strips, respectively, as compared to cropped area. Similarly, nitrate concentrations at the 90-cm depth were reduced by 46%, 85%, 93%, and 94% for 1-m, 6-m, 12-m, and 17-m wide buffer strips, respectively. Soluble P concentrations in subsurface water at 30-cm depth were slightly higher under the buffer strip than in the cropped area, however, statistical analysis showed no significant increase in soluble P concentration in subsurface water at 90-cm depth, indicating no significant subsurface P loss under the grass buffer. These findings suggest that the grass buffer strip is highly effective in reducing N loss in both surface and subsurface water flow and P in surface runoff from agricultural fields.

Implementation of Precision Agricultural in Dryland Cropping System

Authors: *Maysoon M. Mikha (USDA-ARS)*; Shahbaz Khan (Colorado State University); Kyle R. Mankin (USDA-ARS)*

Precision agriculture is a management strategy that could increase land productivity, reduce inputs, and enhance economical return while confronting climate change challenges. The objective of this study is to evaluate management strategies on land productivity with different cropping systems. The study was initiated in 2018 in Akron, Colorado on field size plots range from 2.4-4.5 ha. The plots management consist of: (i) business-as-usual (BAU) with reduce tillage (RT) and two years rotation of wheat-fallow (WF-RT) and (ii) Aspirational (ASP)

with no-tillage (NT) and four-year rotation of winter wheat-corn-millet-fallow (WCMF). Each phase of each rotation was included in each year of the study (2018-2022) with three replications. In each ASP field, three yield management zones were defined as high, medium, or low. In 2019, wheat yield, 5.0 Mg ha^{-1}, with BAU was not significantly different than ASP-high yielding zone, 4.8 Mg ha^{-1}. The ASP-medium 21% and ASP-low 35.7% yielding zones exhibited significantly less yield than the BAU. In 2020, wheat yield was 2.2 Mg ha^{-1} across three zones in ASP which was 7.1% higher than BAU, 2.1 Mg ha^{-1}. Specifically, the ASP-high zone increased yield by 17.5% and by 16.9% in the ASP-medium zone compared to BAU but decreased by 10.8% in the ASP-low zone. The wheat yield in 2020 was lower by 56% with BAU and by 54% with ASP-high zone compared with 2019. The reduction in yield was due to increase the annual temperature (10.3°C compared to 110-year mean of 9.4°C) and low annual precipitation (254 mm compared to 115-year mean of 418 mm). Corn and millet yield with ASP were also affected by 2020 environmental conditions. Average across the three zones, corn yield was 5.0 Mg ha-1 in 2019 compared with 0.59 Mg ha^{-1} in 2020, the reduction of 88%, while millet failed to produce grain yield. Our results suggested that under favorable environment, no differences in wheat yield was observed between BAU and ASP-high yielding zone. As the environment turn to unfavorable, the ASP exhibit higher yield than BAU. Indicating that the ASP has a potential to improve yield and mitigate climate change challenges in dryland cropping system.

Subject: Outreach, Education, and Community Engagement

Location: Room 317 on Main Level

Time: 3:30 PM - 5:00 PM

Applying Social Science to Motivate Farmers and Landowners to Adopt Water Quality Practices

Authors: *Jean McGuire (The Wetlands Initiative)**

The Wetlands Initiative's Smart Wetlands program supports farmers and cropland owners in reducing nutrient loss from Illinois cropland through the construction and use of tile-treatment wetlands. However, the unfamiliarity of this practice and the current voluntary approach to removing excess nutrients from tile drainage water has not provided a motivating benefit or penalty to drive Illinois farmers and cropland owners to adopt this system. TWI is using macro- and micro-level partnerships to increase the adoption of tile-treatment wetlands, as no one entity can bring it to scale. At the macro-level, strategic partnerships are developed to reach a wide range of farm-sector and landowner audiences at the state, regional, and federal levels (See Growing Partnerships and Relationships for Increasing Wetland Practice Adoption- Dr. Jill Kostel). This presentation focuses on the micro-level scale by building relationships with individual farmers, landowners, and their local advisers to get wetlands built on cropland in several Illinois counties. TWI staff are using recent social science findings to develop outreach activities and practices to increase the adoption of Smart Wetlands in north central Illinois. This presentation will focus on three ways we apply social science theory to meet our project goals. First, we discuss how the ecological-sociological systems framework, farmer identity theory, and the farmer-to-farmer learning concept guide our work. Second, it will address why creating long-term, trusted relationships and being adaptive is necessary to get more wetlands on the landscape. Finally, an overview of which groups of local advisers we have found are the best partners to connect us to landowners and create partnerships that benefit all parties.

Gaming Meets Science in Rock Your Watershed!

Authors: *Ann Staudt (Iowa State University)*; Ignacio Calderon (Iowa State University); Chaoqun Lu (Iowa State University)*

Rock Your Watershed!: A Game of Choice and Chance engages players in land use decisions that balance conservation and profitability, directly affecting downstream water quality. Featuring 10 parcels of land within a watershed, players select from urban and rural options that include agricultural, commercial, recreational, and residential uses, crop and grazing options, and a variety of land management decisions (nutrient application rates, implementation of conservation practices, etc.). With 190,000 plays to date, and two Blue Ribbon Awards in Educational Aids from the American Society of Agricultural and Biological Engineers, Rock Your Watershed! has been lauded by teachers and students for its simplicity in conveying key scientific concepts through a frame that allows players to explore and experiment with a broad range of options that promotes what-if testing and better understanding of a complex interconnected system. Rock Your Watershed! is undergoing extensive upgrades in 2023, to be premiered at SWCS in this oral presentation session! Newly expanded climate scenarios will be debuted in Rock Your Watershed! 3.0, to represent interconnections more accurately between climate variability and extremes (precipitation amount, timing, and intensity), water discharge, and nutrient transport. Six unique climate scenarios were identified, with three precipitation levels (low, average, and high) and two levels of intensity (severe and not severe). We analyzed daily water quality monitoring and climate data spanning 4 years (2015-2019) from 4 small catchments in central Iowa, calculating the percent change of mean water discharge and nitrogen loading under each scenario, applying these results to the game's scoring metrics

via unique coefficients for each scenario. Rock Your Watershed! 3.0 is also making a huge technological leap to provide players with a 3-D fully immersive environment to traverse the land parcels and explore the impacts of their choices visually.

Growing Partnerships and Relationships for Increasing Wetland Practice Adoption

Authors: *Jill Kostel (The Wetlands Initiative)**

The Wetlands Initiative's Smart Wetlands program focuses on empowering farmers and agricultural communities to voluntarily reduce their nutrient loss through the implementation of tile-treatment (constructed) wetlands. To make a difference at scale, tile-treatment wetlands and other edge-of-field practices must one day become routine across the Midwest. Unfortunately, these practices are slow to be accepted by landowners due to several challenges: lack of familiarity with the practice and its suitability for their farm, high up-front cost of implementation, and absence of a clear/direct incentive for the farmer in terms of productivity or profitability. Micro- and macro-level partnerships are needed in order to accelerate the awareness and adoption of tile-treatment wetlands as no one entity can bring it to scale. For over a decade Smart Wetlands team has been developing connections and relationships with individuals at traditional and non-traditional "wetland" organizations along two tracks. The first focuses on building relationships with individual farmers, landowners, and their local advisers to form the relationships necessary to get wetlands built on cropland in several north Central Illinois counties (See Applying social science to motivate farmers and landowners to adopt water quality practices by Jean McGuire). The other, and the focus of this presentation, has built strategic partnerships to reach a range of farm-sector audiences at the state, regional, and federal level. The story of how several of these partnerships came together in 2022 to build both a tile-treatment wetland and a restored wetland for a landowner and to host three different outreach and education events during construction will be presented. Our collaborative, data-driven outreach strategies provide a model that can be replicated in tile-drained areas across the Midwest to increase adoption of constructed wetlands and other edge-of-field practices for water quality improvement.

Preparing the Next Generation of Extension Water Stewards

Authors: *John McMaine (South Dakota State University)**

There is little to no training available at the undergraduate level for individuals that go into watershed research, outreach, or management roles with 1) extension or 2) agencies that interact with stakeholders. Undergraduate students are often focused on acquiring a depth of knowledge in one or two disciplines. While this training is necessary, there is a great need for professionals that bring systems perspectives to watershed management. A multi-state extension experience for undergraduates focused on multidisciplinary learning in an applied water resource management context will provide students with broader perspectives and experience in water-related research and extension education. Students will gain real-world experience with the complexities and trade-offs associated with water-related decisions in rural and urban landscapes. In addition, an experience with a multistate exchange will provide students with experience in other ecoregions, agriculture and municipal systems, universities, and cultural contexts. As students are exposed to opportunities in extension, the program will develop an interest in individuals for water management-related careers outside of dedicated research. Specific objectives include: (1) Developing skills in undergraduate students that will empower them to succeed as future extension professionals; (2) Building a cohort of current undergraduates across the north-central region that they can use as a professional network as they move into careers related to watershed

management; (3) Increase the desire of undergraduate students to pursue a career in extension, applied research, or a similar type position with an agency, non-profit, or similar entity.

WEDNESDAY, AUGUST 9

ORAL PRESENTATION DESCRIPTIONS AND AGENDA

Subject: CEAP Showcase

Location: Room 316 on Main Level

Time: 8:30 AM - 10:00 AM

Conservation Effects Assessment Project: Evaluation of Cover Crop Use in Cultivated Cropland Rotations in the United States

Authors: *Candiss Williams (USDA-NRCS)*; Luca Doro (Texas A & M University); Norman Meki (Texas A & M University); Lee Norfleet (USDA-NRCS)*

The Conservation Effects Assessment Project (CEAP) is a multiagency effort to quantify conservation trends and associated environmental effects on cultivated cropland nationally. The USDA Natural Resources Conservation Service (NRCS) used a sampling and modeling approach with natural resource data and farmer surveys to complete two national croplands assessments. The first set of farmer surveys was conducted from 2003 to 2006 (CEAP I) and a second survey was conducted from 2013 to 2016 (CEAP II) with updated natural resource data and additional information to include cover crop use in cropping systems. Cover crops have shown to be effective in controlling soil erosion, increasing infiltration, reducing water quality degradation, and improving overall soil health. As reported in the National CEAP report in 2022, the adoption of cover crops increased from approximately 2 million acres in CEAP I to nearly 19 million acres in CEAP II. Cover crop adoption had significant gains in the Atlantic and Gulf Coastal Plains, North Central and Midwest, and in the Northern Plains production regions. Semi-arid regions and regions with water intensive production systems had lower adoption rates. A modeling exercise was conducted to simulate a wider adoption of cover crops compared to the current cover crop use as described by the CEAP II survey (baseline). Farm fields in CEAP II that did not adopt cover crops as part of their rotation were modeled with cover crops in this exercise (BCC). The estimated benefits on cultivated cropland with cover crops in CEAP II was compared to simulated losses (i.e., sediment and nutrients) with cover crops added to all CEAP point rotations. Given the potential impact of cover crop use due to environmental factors, the results of the simulations were analyzed considering several aspects (i.e., precipitation groups, tillage class, management level) that would identify potential tradeoffs where widespread adoption of cover crops was simulated.

Quantifying Long-Term Regional Groundwater Quality Benefits from Good Agricultural Practices

Authors: *Thomas Harter (University of California Davis)**

The design of regulatory and policy programs that aim at improving agricultural practices is driven by feasibility and cost of practices, but also by an understanding of whether and how much such practices may improve groundwater quality. In some jurisdictions, groundwater quality metrics that define “good” or “drinkable” or “sustainable” groundwater quality set the bar for assessing the desirability/permissibility of agricultural practices. Models developed for policy- and decision-making must account for the complexity of the agro-environmental system yet provide a cost-efficient forecasting tool to assess future scenarios. We have

developed a nitrate forecasting tool for the 50,000 sq.km Central Valley aquifer system. The aquifer system serves about 10,000 community wells, over 20,000 agricultural irrigation wells, and about 100,000 domestic wells. The region is dependent on groundwater for its drinking water. We utilize our recently developed Nonpoint Source Assessment Tool in this Central Valley application (CV-NPSAT). CV-NPSAT extracts a representative steady-state from existing transient subsurface flow models to provide relevant flow fields down to a 10 m scale resolution, then employs an efficient 3D-transport algorithm to hind- and forecast decade- to century scale nitrate dynamics in all wells across the aquifer system. We have validated CV-NPSAT against measured age distributions and against measured history of nitrate pollution in the Central Valley. By combining CV-NPSAT with historic and scenario future field-scale information on nitrate leaching from the root zone, long-term groundwater quality impacts and their spatio-temporal variability are obtained for assessment and evaluation at various spatial scales. Agricultural stakeholders and their regulatory counterparts can employ CV-NPSAT to assess agricultural practices and to guide the industry toward a suite of practices anticipated to bring groundwater quality into long-term compliance.

Temperature, Precipitation, and Discharge Trends in Mark Twain Lake Watershed

Authors: *Claire Baffaut (USDA–ARS)*; Megan Metz (USDA-ARS)*

Global Climate Models (GCM) downscaled to the Central and Upper Mississippi River Basin predict increases in temperatures and precipitation. Eco-hydrologic models driven by these GCM products predict increases in annual discharge and peak flow, but also in the frequency of low flow periods. Early GCM models predicted these outcomes for periods starting as early as 2025, and one would expect that long-term precipitation, temperature, and discharge records would start showing these trends. However, few studies have compared observed trends to GCM-predicted trends in the United States. The objective of this study is to determine whether future climate and associated discharge trends predicted by GCM are already detectable. The study focuses on the Mark Twain Lake watershed, a Conservation Effect Assessment Program (CEAP) watershed in Northeast Missouri. We analyzed potential trends in long-term records (>50 years) of precipitation, temperature, and discharge at annual, seasonal, and monthly scales. We considered multiple climate indicators that characterize extreme and average temperature, rainfall amount, rainfall intensity, discharge, and peak discharge. We found that trends in many temperature and precipitation indicators confirm the trends predicted by the GCM. However, stream base flow, the number of zero flow days, or drought flow (minimum discharge that occurs for a week once in 10 years) have increased at multiple gauges, which contradicts the increasing risk of drought predicted by the GCM and eco-hydrologic models. We will speculate on possible interpretations of this contradictory result.

Water Quality Responses to Varying Flood Conditions in a CEAP Agricultural Watershed with Multiple Conservation Practices

Authors: *Richard E. Lizotte (USDA)*; Lindsey Witthaus (United States Department of Agriculture - Agricultural Research Service); Lucas Heintzman (USDA); Martin Locke (USDA-ARS); Matthew Moore (USDA)*

Long-term establishment of agricultural conservation practices (CPs) in watersheds can improve water quality (WQ), but much less is known about watershed scale resilience to flooding. This study measured surface WQ in a 731 ha established long-term (20+ years) Conservation Effects Assessment Project (CEAP) watershed, Beasley Lake, in Mississippi. Varying flooding conditions occurred from 2008 to 2022. To assess flooding impacts on WQ, nearest-date data from before and after flood events were compared among three flood-stage categories and

spatially analyzed using GIS: minor flooding (99 ha of the watershed inundated affecting 28 ha within CPs), moderate flooding (235 ha of the watershed inundated affecting 69 ha within CPs), and major flooding (332 ha of the watershed inundated affecting 87 ha within CPs). WQ parameters included dissolved solids, suspended solids, orthophosphate, total phosphorus, ammonium, nitrate, nitrite, total nitrogen, and N:P molar ratios. A total of 13 minor, seven moderate, and three major flood events occurred with all three major flood events occurring in later study years (2016, 2018, 2019). During minor flood events, only nitrite significantly increased 82% from pre to post flood conditions. For moderate flood events, dissolved solids modestly decreased (21%) whereas suspended solids greatly increased (259%) and most nutrients increased from 33% to 199% (ammonium) except nitrate and N:P. With major flooding, dissolved solids also modestly decreased (22%) and suspended solids greatly increased (237%) with increased phosphorus from 25% to 164% (orthophosphate) and decreased N:P (36%). Correlation analysis showed greater flood duration (in days) increased suspended solids and nutrients. These results indicate minor flooding had minimal impact on CP effectiveness whereas moderate and major flood conditions affected CP effectiveness, suggesting CPs could provide some resilience to these watersheds during different phases of flooding.

Subject: Climate-Smart Agriculture

Location: Room 317 on Main Level

Time: 8:30 AM - 10:00 AM

Challenges and Opportunities to Transition to Climate-Smart Agriculture in the Inland Pacific Northwest

Authors: *Erin S. Brooks (University of Idaho)*; Jodi Johnson-Maynard (University of Idaho); Sanford D. Eigenbrode (University of Idaho); David Huggins (Washington State University USDA-ARS)*

The Inland Pacific Northwest (iPNW) of the western US is a highly productive agricultural region. The region's Mediterranean climate limits rainfall during the active growing season, creating a challenge for producers. Limited water storage constrains options for adaptation within the region. The primary working solution is to maximize water storage during overwinter periods, which mandates the consideration of mountain snowpacks, groundwater aquifers, and reservoirs in irrigated regions and soil water storage in dryland systems. Similar to most agricultural regions across world, soils in the iPNW have been degraded due to excessive soil erosion, loss of organic matter, acidification, nutrient imbalances and compaction. Degraded soil health threatens the sustainability of crop production under anticipated future conditions. Over the last 10 years several large USDA funded coordinated agricultural projects have led to strong partnerships among research scientists, practitioners, planners, producers, and industry to examine the challenges and opportunities to adapt farming practices to minimize degradation and regenerate the soils of the region. The main goal of these projects and partnerships has been to build cropping systems that are more resilient to extreme weather events (drought, heat, wet springs) driven by climate change. New funding through USDA's Climate Smart Agriculture and Forestry program is enabling the implementation of practices developed over the last 10 years to increase soil carbon and improve nitrogen use efficiency, including adoption of cover and forage crops, and use of precision agricultural technologies. In this presentation, we outline the building of a unique research and implementation partnership to improve and conserve the region's agricultural resources.

Environmental Markets: From Program Chaos to Systems Change

Authors: *Michelle Perez (American Farmland Trust)*; Ryan Anderson (Sierra View Solutions); Robert Parkhurst (Sierra View Solutions)*

To feed the world, mitigate and adapt to climate change, protect water resources, and support farmers, the current agricultural system will need to transform within the next decade. Over the past 10 years, nearly 30 agricultural climate market programs have been created. Farmers have been bombarded with information, yet participation remains low. To increase adoption, many organizations have created farmer-focused guides to these programs, e.g., Illinois Sustainable Ag Partnership, Farm Journal, Purdue University, and United Soybean Board. While these guides have compared the programs and identified the challenges of implementing them, none of them have provided a systematic review and recommendations that will allow the programs to meet the challenges agriculture faces from climate change. Because changing established farming practices is difficult, agricultural climate market programs have struggled to gain farmer traction and scale up. To break through this challenge, we analyzed existing programs and recommended changes for these markets to succeed. This analysis will help farmers, environmental groups, and policymakers understand the barriers to adoption and identify recommendations critical for success. In addition to collecting and analyzing grey and academic literature about emerging markets, and conducting limited interviews with key market stakeholders, we use a multi-level perspective (MLP) to analyze the current state of play. MLP is a framework to describe societal transitions that include changes in consumer preferences, market behaviors, business models, and technologies.

MLP theory organizes transitions as interactions within and between three analytical levels: landscapes, regimes, and niches. Our paper provides a structure, analysis, and recommendations for a roadmap to implementing and scaling successful agricultural climate markets that, if implemented, will create systemic change in the way food is produced on a warming planet.

Impacts of the Extreme Weather, Risk Management, Conservation Nexus on Agricultural Lands of the Inland Pacific Northwest

Authors: *Alex Ayers (University of Idaho)*; J.D. Wulfhorst (University of Idaho); David Huggins (Washington State University USDA-ARS); Erin S. Brooks (University of Idaho)*

The Loessal hills of the Palouse region in the Inland Pacific Northwest are highly vulnerable to erosion due to unique topographic, soil, and changing climatic and extreme weather characteristics in fields with inadequate conservation measures. The increased occurrence of wet springs has led to increased utilization of the USDA Prevented Plant Insurance Program, which lacks conservation requirements. The purpose of this study is to evaluate agricultural practices common among participants in the Prevented Plant Program and analyze the impacts of those actions on producers' vulnerability in relation to the extreme weather-conservation-risk management nexus. The long-term goal of this study is to identify and promote opportunities within the prevented plant program to improve soil health, water quality, and producer success, through increased conservation. This study utilizes WEPP and RUSLE2, to simulate erosion impacts based on current farming practices in the region acquired through a recent survey of agricultural producers. Additionally, the COMET-farm model will be used to quantify greenhouse emissions and carbon sequestration under a variety of farming scenarios. This study covers eight counties across northern Idaho and eastern Washington and is the first of its kind to address the extreme weather-conservation-risk management nexus. Results are expected to indicate that fields left fallow during a Prevented Plant year will have greater erosion than those with conservation measures in place such as cover cropping and could potentially have the additional benefit of increased carbon sequestration. We anticipate this analysis will further discourse and improve conservation policies within the Prevented Plant Program to combat erosion. Next steps from this work entail continued collaboration with producers, public and private regulatory and research entities, and the USDA to integrate conservation and risk management practices into the Prevented Plant Program.

Risk and Ambiguity Aversion in Conservation Practice Adoption and the Effectiveness of Carbon Payment Systems

Authors: *Zhushan Du (Iowa State University)*; Hongli Feng*

There has been a growing interest in conservation practices in agriculture. Different carbon payment systems have been initiated, which vary greatly in terms of carbon measurement and verification and contract payment structure. To fully comprehend the various carbon payment systems, it is essential to understand how farmers respond to these systems. One critical factor is uncertainty, as carbon sequestration processes are inherently stochastic, and the scientific understanding of these processes is unclear. This paper adds to the literature by examining the effect of uncertainty on farmers' decision-making in conservation practices adoption and the cost-effectiveness of different carbon payment systems. There are two types of uncertainties related to carbon payments: one with known statistical distributions and one with unknown statistical distributions. We incorporate both types of uncertainties into two carbon payment systems, practice-based payments that are fixed per acre of practice adoption versus outcome-based payments that vary with carbon outcomes. We first

analyze the effects of uncertainty with economic theory and then estimate those effects with economics experiments and a biophysical model. We show that uncertainty premium will increase the minimum payments to farmers for adopting carbon sequestration practices such as no-till and cover crops. Our preliminary results show that the premium needed for adoption can be twice as much as the direct costs of the practice. Practice-based carbon payments are significantly more cost-effective than outcome-based payments, given farmers' reaction to uncertainty. Our intended target audience are researchers, policymakers, industry leaders, farmers, and others interested in conservation practices adoption and the effects of different carbon payment systems.

Subject: Edge-of-Field Practices and Monitoring

Location: Room 318 on Main Level

Time: 8:30 AM - 10:00 AM

Assessing the Value of a Public-Private Partnership to Target Best Management Practices to Legacy-Phosphorus Fields

Authors: *Michael Brooker (Ohio State University)*; Jay Martin (Ohio State University); Madison Kacica (Ohio State University); Erin Ebersbach (Ohio State University); Nathan Stoltzfus (Ohio State University); Sam Francis (Ohio State University); Margaret M. Kalcic (University of Wisconsin-Madison); Ryan Winston (Ohio State University); Kevin King (USDA-ARS); Robyn Wilson (Ohio State); Brian Roe (The Ohio State University); Greg LaBarge (Ohio State University Extension); Jessica D'Ambrosio (The Nature Conservancy); Chad Penn (USDA-ARS)*

Phosphorus (P) loads from agricultural sources are a key contributor to the recurrent harmful algal blooms (HABs) in Lake Erie. To reduce the size of future HABs, a targeted approach is recommended to site best management practices (BMPs) where they will be most effective: at heavy-polluting fields. Based upon a known relationship between soil and dissolved-P losses, legacy-P fields - where soil-P has accumulated beyond agronomic needs – were recruited for a targeted BMP approach in the Lake Erie basin. Through a public-private partnership, we recruited nine legacy-P fields for edge-of-field and BMP (e.g., P-filters, wetlands) monitoring. Additional data was obtained from the USDA edge-of-field network to compare loads from legacy- and nonlegacy-P fields. Our objective was to assess the value added by a targeted approach to conservation efforts. We quantified loads and BMP reduction rates using monitoring data, and then estimated the potential of P-filters to reduce watershed loads using results from a Soil and Water Assessment Tool model. Monitoring revealed similar P loads being lost from legacy-P compared to other fields on average. Further analysis showed that siltier soils in legacy-P fields corresponded with greater P loss. This additional information could help locate legacy-P fields that yield the greatest nutrient loads. The P-filters reduced dissolved-P at rates that meet water quality goals (>40%). Modeling showed a two-fold increase in P load reduction through a targeted compared to non-targeted siting of P-filters. Our results suggest a path for more refined targeting through a watershed-scale public-private partnership. Using knowledge about soil types could screen out lighter polluting legacy-P fields so that practices can be sited near the heavy polluting sites where they make the greatest impact.

Crop and Water Monitoring Networks with Low-Cost Technology

Authors: *Ansley Joseph Brown (Colorado State University)*

Making meaningful changes in agroecosystems often requires the ability to monitor many environmental parameters to accurately identify potential areas for improvement in water quality and crop production. Increasingly, research questions are requiring larger and larger monitoring networks to draw applicable insights for both researchers and producers. However, acquiring enough sensors to address a particular research question is often cost-prohibitive, making it harder to draw meaningful conclusions from data collection. Even if enough sensors can be acquired, often data cannot flow freely between sensor manufacturer data platforms, adding to the time and labor costs associated with data analysis and delivery. This can also prohibit real-time data access, which is critical to subsequent decision making (e.g., deciding whether to apply fungicide to a sugarbeet crop). To help address these concerns, the Colorado State University Agricultural Water Quality Program (AWQP) has developed low-cost, edge-of-field (EoF) and crop health monitoring systems with Internet of Things (IoT) technology for scalable, near-real-time research. For EoF monitoring, the AWQP developed an automated water sampler that could detect flow depth and sample water remotely for approximately 1/10th of

the cost of an equivalent commercial model. The sampler was deployed in 5 research locations across Colorado in 2022. For crop health monitoring purposes, the AWQP worked with Western Sugar agronomists to develop a temperature and humidity sensor capable of calculating daily infection values of Cercospora leaf spot for optimized fungicide applications. After harvest, this device can interchange sensors to become a sugarbeet storage pile temperature monitor. All developed sensors have been compared to commercial/existing methods for monitoring, and the results will be discussed.

Estimating the Soil Water Retention Using Particle-Size Distribution of Sand Soils

Authors: *Judyson de Matos Oliveira (University of Florida)*; Fernando Rodrigo Bortolozo (University of Florida); Lincoln Zotarelli (University of Florida); Cassio Antonio Tormena (State University of Maringá); Allan R. Bacon (University of Florida, Soil and Water Sciences Department); Julio Pachon (University of California)*

Northeast Florida (NF) is an important vegetable production area with approximately 17,400 ha, predominantly sandy soils irrigated by sub-irrigation methods. The development of irrigation tools to assist growers in increasing soil and water conservation is needed. The available water to the plant (AW) can be estimated using the soil water retention curve (SWR). Determining representative SWR requires intensive soil sampling and refined lab techniques, which are time-consuming and costly. Alternatively, the SWR can be indirectly estimated using a particle-size distribution (PSD), which is faster and lower cost than conventional methods. The objective of this study was to develop a procedure to estimate the SWR using the PSD and soil bulk density (Bd) data for sandy soils of the agricultural areas of NF. From twenty areas sampled in NF with coarse sand ranging from 13.22 to 273.48 $g.kg^{-1}$, five representative areas were selected, and undisturbed soil samples (n=318) were taken from 0-0.40 m soil depth in each area for SWR determination. The SWR and Bd were determined by conventional methods, and the PSD was determined by the laser diffraction method. SWR data was also estimated from the PSD and Bd data using a modeling procedure developed based on the physical-empirical model approach. Genuchten's model was fitted to SWR data from both approaches: experimentally (VG) and derived from PSD and Bd data (VG_PSD). The lowest coefficient of determination and index of agreement by VG_PSD were 0.90 and 0.78, respectively, and the root mean square error ranged from 0.026 to 0.035 m^3m^{-3}. The VG_PSD errors were mainly associated with θ above 0.15 m^3 m^{-3}. The differences between AW estimated by VG_PSD and VG were lower than 0.01 m^3m^{-3}. The modeling procedure showed a great predictive performance to estimate SWR for soils with total sand above 932 $g.kg^{-1}$; however, its application for soils with a broader particle-size distribution and hierarchical structure should be further investigated.

Missing the Trees for the Forest? Specialized Native Pollinator Biodiversity in Support of Conservation in Agriculture

Authors: *Scott D. Longing (Texas Tech University)*; Brendan Kelly (Dept Plant and Soil Science, Texas Tech University)*

Pollinators are threatened globally, placing a broad biodiversity at risk, and compromising ecosystem services including pollination that supports crop production. Conservation of pollinator biodiversity in agriculture involves voluntary programs aimed at enhancing resources on farms including nectar, pollen, soil, and freshwater. However, few specific biological targets exist for monitoring habitat improvements or pollinator communities affected through conservation actions. Furthermore, while approximately 25 percent of native bees are considered pollen specialists, these specialized bee and plant populations in fragmented grasslands have been understudied, placing biodiversity at risk. Where specific linkages are known between plants and

native bees (i.e., specialization) and species' occupancy is predicted to be high under natural/least-affected or restored conditions, specialist populations could serve as targets for conservation program monitoring. We present a case of a plant-bee system involving bristly Nama and a group of Nama-specialist bees (Hymenoptera: Halictidae: Rophitinae) from a U.S. Southern High Plains agricultural landscape. Because of their affinity for Nama, these bees have been under-reported in regional pollinator biodiversity studies using passive sampling techniques yet could potentially be applied as regional targets in ecological restoration and conservation.

Subject: Water Resource Assessment and Management

Location: Room 319 on Main Level

Time: 8:30 AM - 10:00 AM

Evaluating a Two-Stage Roadside Ditch Design to Improve Environmental Performance Using 2D Modeling in HEC-RAS

Authors: *Ingrid Cintura (Iowa State University)*; Antonio Arenas (Iowa State University); Keith Schilling (Iowa Geological Survey); Matthew Streeter (University of Iowa); Elliot Anderson (The University of Iowa); Marian Muste (The University of Iowa)*

Iowa's most pressing environmental challenges are related to its agricultural activities. Waters in the state are impacted by nutrients and sediments exported from agricultural fields. Despite roadside ditches being an underappreciated practice, some studies have shown that implementing two-stage ditches can reduce turbidity, increase nitrogen removal, and improve habitat. The objective of this study was to evaluate the environmental benefits of a two-stage ditch design using water quality and hydraulic models. The study area includes a "0.8" mi^2 watershed and a 1632 ft. existing ditch in Benton County, Iowa. The predominant land cover is cultivated crops. The pre-implementation model was calibrated against stage data, nitrate concentrations, and turbidity collected upstream and downstream from the existing ditch. Measured data show that the values of turbidity and nitrate were reduced from 6 NTU (Nephelometric Turbidity Unit) to 2 NTU and from 10.5mg/l to 9 mg/l, respectively. The results of the simulations showed that with the two-stage ditch, there is a 25% reduction of the hydrograph peak for the 1yr storm event. The calibrated model shows and quantifies the environmental impact and benefits of a proposed two-stage trench, for different design storms. Our study will inform people interested in implementing two-stage ditch designs to reduce sediment and nutrient exports from farmland.

Integrating ANNs Predicted Saturated Hydraulic Conductivity and Evapotranspiration to Optimize Drainage System Design

Authors: *Murad Ellafi (Cranfield University)**

Agricultural drainage in irrigated lands has been installed to manage soil salinity and waterlogging problems. However, less than 10% of all irrigated lands in developing countries (DCs) requiring drainage are currently drained. DRAINMOD is a versatile and readily available model that can be used to evaluate alternative drainage designs. DRAINMOD requires several inputs, including saturated hydraulic conductivity (Ksat) and reference evapotranspiration (ET0). In DCs, measuring these data is expensive and time-consuming. This research evaluated alternative methods of predicting Ksat and ET0 to overcome incomplete data records that restrict drainage designs using DRAINMOD for two Libyan irrigation schemes. Ksat predictions used Artificial Neural Networks (ANNs), Rosetta3, and ET0 predictions used ANNs, MODAWEC, and Era5-Land. The researchers used four combinations of data inputs to predict Ksat and ET0 values, with results showing that ANNs were more accurate than other indirect methods predicting Ksat and ET0. The research also showed that constructing drainage systems based on the ANN predictions can result in accurate drain spacing, which is similar to the optimum design based on measured Ksat and ET0. However, using the other indirect methods for predicting Ksat and ET0 resulted in significant wheat and beans losses. Further research is needed to evaluate the impacts of reusing drainage water to irrigate more salt-tolerant crops and improve water use efficiency. Overall, the study highlights the potential of using data-driven approaches in developing countries to improve the cost-effectiveness and accessibility of agricultural drainage systems.

Mapping the Spatial Distribution of Natural Infrastructure Practices in the Mississippi River Basin

Authors: *Elliot S. Anderson (University of Iowa)*; Keith Schilling (Iowa Geological Survey); Jerry Mount (the University of Iowa)*

Natural infrastructure practices mitigate flood risk and improve water quality by restoring or replicating natural ecosystem processes. Several practices have become common throughout the Mississippi River Basin, and there is great interest in expanding natural infrastructure to reduce the risks of flooding and nitrogen export in the basin. In this study, we mapped the potential installation of eight natural infrastructure practices throughout the Mississippi basin, including wetlands, targeted land use change, floodplain reconnections, and other practices. These potential practices were identified using a geographic information system that analyzed geospatial data from a variety of publicly available databases. Many practices are limited by land use, slope, and agricultural drainage systems—leading to significant spatial variation in their viability. All NI practices were quantified at a 10-meter scale, where the potential use of natural infrastructure within a HUC12 watershed can be linked with other hydrologic characteristics. We explore the spatial variation of potential NI implementation at several different spatial scales throughout the Mississippi and investigate the extent to which these practices can be established in states, basins, and small watersheds. Understanding the spatial distribution of natural infrastructure will help policymakers prioritize areas that have viability for practices along with flood and water quality risks.

Rural Landowners: Key Partners in Successful Invasive Species Management in Wetland Restorations

Authors: *Kaitlyn O'Connor (ISG)**

The wetland bank program is a system where public and private entities can restore wetlands to create credits that are used to offset authorized wetland impacts elsewhere within the watershed. The number of credits, and ultimately dollars, a landowner can earn from a privately owned wetland bank relies in part on the quality of vegetation within the wetland restoration. At the end of a five-year monitoring period, the relative percent cover of nonnative or invasive species must typically be below 10% for credit release. In this way, the wetland bank program incentivizes landowners to be active land managers and control invasive species on site. Although rural landowners in agricultural watersheds may not have experience managing diverse wetland plant communities before starting a wetland bank project, with some guidance from a consultant, they can often leverage their skills and equipment to effectively manage invasive species. In this presentation, we will discuss how storytelling can be used to inspire a commitment to high-quality restoration outcomes, tools to effectively convey technical information in an approachable way, and lessons learned while collaborating with landowners.

Subject: Adaptive Management of Conservation Efforts

Location: Room 316 on Main Level

Time: 10:30 AM - 12:00 PM

Climate-Smart Agriculture for Subsoil Carbon Storage in the Southeast US

Authors: *Sindhu Jagadamma (University of Tennessee)**

Soils contain the largest stock of organic carbon (C) in terrestrial ecosystems, and this massive pool of C is quite vulnerable to climatic changes and other environmental perturbations. Soil organic carbon (SOC) sequestration offers multiple benefits, including soil-air-water quality, crop productivity, and climate change mitigation. Aspirational agricultural practices such as reduced tillage, crop rotations, and growing winter cover crops greatly increase SOC accumulation in agroecosystems. However, in croplands under warm and humid climatic conditions, such as those in the southeast US, it is challenging to achieve net SOC storage as the environmental conditions favor SOC decomposition over accumulation. One way to enhance the stability of SOC in such environments is to promote its accumulation in the subsoil. This talk will focus on some promising options to achieve subsoil SOC sequestration in the southeast US.

Evaluation of Watershed Indicators and Trade-Offs in Ecosystem Functions Pre- and Post-Industrial Solar Farm Installation

Authors: *Benjamin Turner (Texas A&M University-Kingsville)*; Luis Mier-Valderrama (Texas A&M University-Kingsville)*

Interest in industrial-scale solar farm development has accelerated along with private and public investment in alternative energy. Due to an array of regulatory, political, and economic incentives, much of this development has taken place in rural working landscapes historically used for agricultural production. Little is known about the soil- and water-related impacts at watershed scales resulting from land use intensification resulting from industrial solar farm development. Here we designed a watershed assessment and monitoring protocol for Pond Creek, a humid subtropic, low stream order, southern plains watershed in central Texas. Land use is primarily crop cultivation and secondarily pasture for cattle grazing. Presently, several industrial-scale projects are planned to convert ≈15-30% of Pond Creek from agriculture to solar farms. The protocol included a suite of more than 10 indicators including: bank full width, band height ratio, entrenchment ratio, presence and length of point bars, aggradation, bank soil stability, bank cover, riparian cover, and presence and length of pools. Indicators were measured at two locations, one at the creek headwater and one nearer its outlet to the Brazos River. Site visits for data collection were made in March 2022 (pre) and 2023 (post) while soil indicator data at solar farm development sites was also measured. We discuss initial observations and considerations for watershed monitoring given changes in land use intensity from solar farm development as well as some potential high leverage strategies likely applicable to solar farm sites or whole watersheds where they reside. With accelerated demand for rural solar farm development, greater attention is warranted from the soil and water conservation community to better prepare for the impacts such changes will have across working landscapes.

Why Do Water Users in The Lower Rio Grande Valley Operate Independently Rather Than Collectively Despite Shared Water Resource Challenges Involving Future Availability?

Authors: *James Russell (Texas A&M University-Kingsville); Kendall Cloud (Texas A&M University-Kingsville); Chase Crandall (Texas A&M University-Kingsville); Benjamin Turner (Texas A&M University-Kingsville)**

Water resource systems in South Texas are often stressed by exogenous environmental factors (such as rainfall variability and exceptionally high temperatures) and endogenous regulatory and decision-making policies which drive decision-makers and other stakeholders. This project examines the hydrologic and socio-economic system structures and resulting water user and decision-maker interactions in the Lower Rio Grande Valley (LRGV). The objective of this study was to gain insight on why water users within the LRGV system operate independently of other users despite the common threats they share (such as frequent and intensifying drought, an increasing demand for water in Texas, and shortfalls and delivery delays from Mexico) which often impact numerous irrigation districts, agricultural producers, and municipalities of the region. Using literature reviews, stakeholder interviews and mental models, and water resource monitoring data, we developed a causal loop diagram (CLD) model of the LRGV system. Leverage points within the CLD included the transfer of conservation knowledge between farmers and district leaders (farmer to farmer, farmer to district, district to district, and district to state and municipal) as well as stakeholder communication to encourage cooperation between users (ranging from federal and state policymakers to individual farmers). Proposed interventions to improve water resource management in line with these leverage points consisted of an increase of district funding for training the next generations of irrigation district managers, programming to support knowledge transfer to municipal leaders, as well as the increase in public water user meetings by farmers, irrigation district leaders, and municipal leaders, which can be facilitated by the participation of the federal and state commissions.

Subject: Conservation Models, Tools, and Technologies

Location: Room 317 on Main Level

Time: 10:30 AM - 12:00 PM

A GIS-based WEPP Modeling Approach to Locate and Quantify Vulnerable Fields Prone to Hillslope Soil Loss at the HUC12 Level

Authors: *Eduardo Luquin (Iowa State University)*; Chelsea Ferrie (Iowa State University); Emily K. Zimmerman (Iowa State University); Brian Gelder (Iowa State University); Daryl Herzmann (Iowa State University); David James (USDA-ARS National Laboratory for Agriculture and the Environment); Richard Cruse (Iowa State University)*

To appropriately place soil conservation measures, locating the most vulnerable areas prone to soil erosion is required. Available tools to locate vulnerable areas are tedious to use and time-consuming, and most water erosion estimations are based on empirical models with limited applicability. This study aims to develop and test the capabilities of a GIS-WEPP tool that quantifies mass of soil and water transported from hillslopes and locates vulnerable agricultural fields at the HUC12 watershed level. The present study takes advantage of two large-scale soil and water conservation tools available for the Midwest U.S., the Daily Erosion Project (DEP) and the Agricultural Conservation Planning Framework (ACPF). The DEP provided WEPP simulations of runoff and sediment delivery and binned these into classes by similar slope, soil erodibility, and land use. The ACPF database provided combinations of soil erodibility factor, land use, and slope within the watershed. These unique combinations in the watershed were queried against the DEP categories, and matching combinations were assigned the corresponding sediment delivery rates. The newly developed tool was implemented in 24 HUC12 watersheds covering six Major Land Resource Areas (MLRAs) in Iowa (4 HUC12s randomly selected per MLRA). Preliminary results identify the tool's utility for locating and estimating hillslope soil loss per field, corroborating the spatial variability of soil erosion within watersheds and MLRAs. At a larger scale, the tool's average hillslope soil erosion rates at the HUC12 level agreed with DEP long-term estimates (0.7-4.8 t/ac/yr). The development and expansion of this tool has the potential to redirect soil and water conservation efforts based on distributed parameter, continuous, and event-driven simulations to more effectively identify opportunities to address soil erosion in agricultural landscapes.

Automation of Lateral Move Irrigation System for Irrigating Cotton Using Wireless Soil Moisture Sensors Network

Authors: *Udayakumar Sekaran (Oregon State University)*; Jose O. Payero (Clemson University); Dana Turner (Clemson University)*

In South Carolina, overhead sprinkler systems are typically used to irrigate row crops. Although farmers in South Carolina have adopted efficient irrigation systems (i.e., center pivot and drip), managing these systems to achieve their full potential is still challenging. This project's overall goal was to create and field-test an affordable system to help cotton farmers increase water use efficiency by automating irrigation based on real-time soil moisture data using a wireless sensor network. The specific objectives were to: (1) develop a wireless sensor network to automate irrigation scheduling of cotton, based on real-time soil moisture using a lateral move irrigation system and. (2) field-test the irrigation automation system by evaluating the response of cotton to three irrigation trigger points. A wireless soil moisture sensor network prototype created in 2019 to automate irrigation of cotton using a subsurface drip irrigation (SDI) system was modified and adapted to a lateral move irrigation system. A field experiment was conducted at the Edisto REC in 2020, 2021, and 2022 to field-test the

irrigation automation system. In this experiment, three irrigation treatments were evaluated in which irrigation was automatically applied to cotton when the weighted-average soil moisture reached either -30, -40, or -50 kPa using four replications. Soil moisture was measured using Watermark moisture sensors installed at three depths in each plot. The electronics and software for the automation system were developed and installed in the field. Field tests conducted in 2020, 2021, and 2023 showed that the new automation system performed as expected.

Developing Quantitative Cropland State-and-Transition Models Using Bayesian Network Analysis

Authors: *Jonathan J. Maynard (USDA-NRCS)*; Shawn Salley (USDA-NRCS); Skye Wills (USDA-NRCS); Ekundayo Adeleke (USDA-NRCS-NSSC); Travis Nauman (USDA-NRCS); Jamin Johanson (USDA-NRCS)*

Ecological sites (ESs) and state-and-transition models (STMs) are part of a resilience-based management framework used to classify land with similar ecological potential based on its biophysical properties (e.g., soil, climate, and potential vegetation), land condition, and its response to disturbance. While originally developed for rangelands, ESs and STMs are being developed for croplands to increase ecosystem services, support conservation planning, and maximize land health. ESs and STMs are conceptual models, developed by technical experts, that describe the patterns and drivers of ecosystem dynamics in landscapes with similar capability. These conceptual models largely exist in narrative form, with qualitative descriptions and ranges of ecosystem attributes relating to potential ecological states and state transitions. Leveraging recent work on dynamic soil properties and soil health indicators in different cropland management systems, this project will explore the development of quantitative cropland state-and-transition models using a Bayesian network modeling framework. To accomplish this, we developed quantitative soil and ecosystem property distributions for an ecological site and its corresponding states within an agricultural-dominated landscape using a range of soil (e.g., SSURGO, EDIT, NASIS, KSSL, DSP4SH) and environmental (e.g., climate, terrain, remote sensing) datasets. Our presentation will discuss how quantitative STMs can improve our understanding of the effects of agricultural management on land health and ecosystem function.

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Location: Room 318 on Main Level

Time: 10:30 AM - 12:00 PM

Accelerating Progress toward Agricultural Water Quality Goals: Insights from a Technical Assistance Network Approach in the Chesapeake Bay Watershed

Authors: *Kristin Fisher (The Nature Conservancy)*; Dean Collamer (Growmark FS); Ben Hushon (The Mill); Matthew Houser (The Nature Conservancy)*

Agricultural nutrient runoff is the dominant contributor to degraded water quality across the United States (US). Through the widespread adoption of advanced nutrient management practices, the extent of this issue could be significantly mitigated without harming agricultural production or farmers' profitability. Given the voluntary policy approach dominant in the US, farmers ultimately must choose to adopt these practices. However, farmers face significant contextual barriers that structure their decision-making and advanced nutrient management practice adoption remains low across critical agricultural regions at least in part because of these constraining factors. A critical question is therefore how to more effectively encourage and enable voluntary behavior change within the US agricultural system. Toward identifying innovative approaches to affect rapid and widespread practice adoption, this study synthesizes and reviews the work of the 4R Nutrient Stewardship Association in the context of the Chesapeake Bay Watershed. In the mid-Atlantic states of Delaware, Maryland, and Pennsylvania, voluntary 4R Alliances have been established to promote the use of advanced nutrient management "4R" practices: using the right source, at the right rate, at the right time, and in the right place. Leveraging farmers' high use and trust in private sector advisors - agribusiness retailers and consultants - the Alliances have worked to engage trusted private sector advisors to advance these 4R conservation practices among their clientele. In this presentation, the structure and goals of the Mid-Atlantic 4R Nutrient Stewardship Association, comprising the Pennsylvania and Delaware/Maryland 4R Alliances, will be reviewed, along with examples of implemented projects and lessons learned for engaging private sector advisors in this work and administering innovative incentive programs to accelerate progress toward meeting water quality goals.

Promoting Adoption of Precision Nitrogen Management Technologies through On-Farm Research

Authors: *Seth Norquest (University of Nebraska)*; Laura Thompson (University of Nebraska); Laila Puntel (University of Nebraska); Taro Mieno (University of Nebraska Lincoln); Javed Iqbal (University of Nebraska); Joe Luck (University of Nebraska)*

Nebraska On-Farm Research consists of a network of professionals that assist farmers in evaluating products and practices that will potentially have a positive impact on the productivity, profitability, and sustainability of their operations. The precision nitrogen (N) management project (PNP) was developed to allow farmers to get hands-on experience with new technologies that may improve nitrogen use efficiency (NUE) and provide data and support to help them decide how these technologies may fit in their operation. Many farmers already have technology that enables them to easily conduct on-farm research such as GPS, yield monitors, and variable-rate application (VRA) equipment. One technology sector in Nebraska that could have improved adoption is the use of precision nitrogen management technologies. Nitrogen management can be challenging due to its high mobility in the soil. Nitrogen leaching into the groundwater impacts water quality and can have negative economic and social ramifications. Nitrogen management technologies aim to increase the efficiency of N fertilizer and therefore reduce N losses to the environment. The technologies are tested for corn and wheat and include crop-model based applications, sensor-based applications, nitrogen inhibitors, and biological fixation

products. We've given farmers a hands-on experience with these technologies. There are 40 trials established in each of the three experimental years. Innovative experimental design, in-season data collection for validation, and an automated data processing tool are used to evaluate each trial to give farmers actionable results. In the first year of this study, 98% of the experiments were successfully established. Ninety percent of the successfully established studies were analyzed using the automatic data processing method. The impact of these studies was measured by documenting incremental changes in N management and technology adoption.

Working with the Agricultural Community to Focus Practices for Watershed Phosphorus Reductions

Authors: *Jay Martin (Ohio State University)*; Laura Johnson (Heidelberg University); Greg Labarge (Ohio State University Extension); Carrie Dale Shaffer-Morrison (Ohio State University); Robyn Wilson (Ohio State); Michael Brooker (Ohio State University); Denna Clem (Hardin Soil and Water Conservation District); Peter McDonough (Ohio Department of Agriculture); Brian Roe (The Ohio State University); Angelica Vazquez-Ortega (Bowling Green State University)*

For decades Lake Erie has been experiencing eutrophication with some of the largest harmful algal blooms (HABs) in the past 11 years. The HABs in Lake Erie are closely associated with phosphorus (P) loading, from the Maumee River during the period of March through July and the primary source of this loading is agricultural runoff. To reduce the frequency of severe blooms, a target of 40% reduction in total P and dissolved P loads from the Maumee River was set in 2015. While practices have demonstrated water quality benefits at the field-scale, no movement toward this goal has been noted across the 4-million-acre watershed. The goal of the Pilot Watershed project is to address this limitation by focusing practice adoption and water quality monitoring on a 6,000-acre watershed to test a modeling hypothesis that adoption of practices on 70% of acres can achieve the 40% phosphorus reduction target. With funding from an NRCS-RCPP-AFA project and other partners, we will utilize multiple methods to reach this threshold of practice adoption including (1) practice payments that substantially exceed those from other programs, (2) advocation for the project and practices by crop advisors affiliated with partnering agricultural retailers, and (3) agglomeration where payments for phosphorus placement will increase with greater enrollment of acres. This presentation will report on the initial success of these methods towards practice adoption, as the project formally began in February 2023, and the first attempt at recruitment will occur in spring 2023. We anticipate this project will demonstrate how to support productive agriculture and water quality in Great Lakes watersheds and offer guidance as similar techniques are deployed in other watersheds.

Subject: Social Sciences Informing Conservation

Location: Room 319 on Main Level

Time: 10:30 AM - 12:00 PM

A "Stepladder" Towards Adoption of Multiple Complementary Conservation Practices: Iowa Farmers' Concurrent Use of No-Till, Cover Crops, and Extended Rotations

Authors: *Laurie W. Nowatzke (USDA)*; J.G. Arbuckle (Iowa State University)*

The prevalence of corn and soybean production in Iowa is a driver of high levels of nitrogen and phosphorus loss to the Mississippi River and, ultimately, the Gulf of Mexico, where excess nutrients lead to hypoxic aquatic conditions. Many states currently rely on voluntary mechanisms for encouraging the adoption of agricultural conservation practices to mitigate these environmental impacts. This study aimed to understand factors that influence farmers' adoption of a set of three complementary conservation practices—no-till, cover crops, and extended crop rotations. We utilized survey data from 3,600 Iowa row crop farmers and offer a novel approach to measuring farmers' progress towards adopting a set of three practices. We found that several factors were significantly associated with a farmer's odds of being open to adopting or having adopted multiple practices. The following factors were positively associated with a farmer's odds of having adopted multiple practices: support for action related to nutrient loss; influence from nongovernmental, on-farm research organizations; and acres of pasture. By contrast, the following factors were negatively associated with a farmer's progression toward adopting these three practices: perceptions of agronomic barriers to conservation implementation; and proportion of total farmland that is rented. This study presents a potential framework for better understanding farmers' varied and gradual adoption of a three-practice conservation system on Iowa farms. This work provides an important contribution to conservation adoption literature by examining multiple practices concurrently. Results may help guide short- and long-term outreach and education strategies that aim to promote the use of multiple complementary practices.

Investigating Physical and Behavioral Drivers of Nutrient Loading Using a Farmer Survey

Authors: *Andrew Hillman (UW-Madison)*; Margaret M. Kalcic (University of Wisconsin-Madison); Anita Thompson (University of Wisconsin-Madison); Amber Mase (University of Wisconsin - Madison); Joe Bonnell (UW-Madison)*

Located in the geologically unique Driftless region of Wisconsin, the Sinsinawa watershed has potential as a high-quality system for wildlife habitat, agriculture, and recreation. However, many reaches are currently impaired for phosphorus due to highly sloped terrain and the dominant land uses in the area: row crop agriculture and livestock pasture. This area is also of interest due to the low level of conservation outreach to date by UW Extension compared to other areas of the state. Nutrient loading is driven by both physical vulnerability and land management, with suboptimal management of vulnerable landscapes causing disproportionate levels of loading. To begin to decouple the effects of land management and physical vulnerability in the Sinsinawa watershed, a survey was distributed to about 250 landowners in this area in early 2023. The questionnaire asked about nutrient management and conservation practices as well as respondents' attitudes and values towards the environment, farming, and agriculture. Results will be used to group farmers (e.g., productivist, conservationist) based on typologies developed previously in the conservation adoption literature. Further analysis will explore the relationship between farmer types, self-reported conservation behaviors, and the perceived vulnerability of the farmland to erosion and nutrient loss. This will allow the researchers to investigate the degree to which disproportionality of environmental impacts exists in the

watershed and how more vulnerable lands tend to be managed. The current policy framework to encourage the adoption of conservation practices may not be effective at dealing with the disproportionate nature that can drive nutrient loading. Linking physically observable management actions to farmer typologies could facilitate a more targeted approach to designing outreach programs and conservation policies that address disproportionate levels of risk and impacts from farming practices across a watershed.

Our Daily Bread in the Heartland; Understanding Farmer Diversification to Small Grains in Corn and Soybean Systems

Authors: *Lauren S. Asprooth (University of California, Davis)**

The majority of agricultural lands in the Upper Midwest are planted to corn and soybeans, resulting in a lack of crop diversity that lowers the resilience of local farms, food systems, and natural ecosystems. Small grains such as barley, oats, rye, and wheat are an obvious first step in diversifying corn and soybean rotations as they fit well in large-scale row crop systems, provide agronomic and environmental benefits, and offer a source of local grain that has been missing from the basket of local foods available to consumers in the region. Yet, few farmers in the Upper Midwest grow small grains and those who do struggle to earn a profit. This research identifies the barriers farmers face to growing small grains and the factors that have helped some to be successful in their small grain operations. We do so through a survey of 326 row crop farmers and interviews and focus groups with 38 farmers and stakeholders throughout the grain chain in the states of IA, IL, MN, and WI. A combination of farmer-reported results, correlation network analysis, and findings from focus groups and interviews shows a myriad of interconnected reasons why farmers do or do not grow small grains including: availability of markets and market price, access to equipment, timing of planting and harvesting, availability of cost share for planting small grains, beliefs regarding the soil health benefits of small grains in rotations, organic certification, integration of crops and livestock on-farm, and small grain genetics. Access to technical assistance and farm policies including crop insurance and revenue support for small grains were comparatively less important. To enable strong agricultural markets and support farmers to produce small grains, it will be important to invest in market development and improved genetics, promote organic agriculture and integrated crop and livestock production, and to level the playing field with corn and soybeans in terms of farm policy and supply mandates.

POSTER PRESENTATIONS

Effect of No-tillage, Cover Crop and Biochar Application on Net Global Warming Potential in Asian Organic Soybean Production

Authors: *Huang Qiliang (Tokyo University of Agriculture and Technology)*; Rahmatullah Hashimi (Tokyo University of Agriculture and Technology); Ratih Kemala Dewi (Tokyo University of Agriculture and Technology); Gong Yingting (Guangdong Academy of Agricultural Sciences); Li Peiran (South China Institute of Environmental Sciences); Masakazu Komatsuzaki (Ibaraki University)*

Owing to their effectiveness in reducing global warming potential (GWP), no-tillage (NT) and cover crop introduction are widely used as climate-smart agriculture practices. To explore the biochar effect on soil organic carbon (SOC) sequestration and GWP, a split-split-plot experiment was conducted at the Center for International Field Agriculture Research and Education, Ibaraki University, Japan, with different combinations of two tillage methods (NT; Moldboard plowing, MP), two cover crop treatments (Fallow, FA; Rye, RY), and two biochar treatments (with biochar application, WB; no biochar application, NB). NT and RY exhibited higher nitrous oxide (N2O) emissions than MP and FA. WB showed a lower N2O emission than NB under NT, suggesting that biochar application reduced the extra N2O emission due to NT. NT, RY and WB showed a great potential on SOC stock improvement. On average, SOC stocks under NT, RY, and WB were 8.7%, 4.4%, and 6.5% higher than those under MP, FA, and NB in 2020, and were 11.3%, 8.2%, and 17.2% higher in 2021. Owing to the enhanced SOC stock, net carbon dioxide (CO2) retention could fully offset the GWP from non-CO2 emissions. Thus, NT combined with RY and WB positively contributed to the decreased net GWP in the soybean field (-730 kg CO2 equivalent ha-1 year-1 in 2020 and -4808 kg CO2 equivalent ha-1 year-1 in 2021). These findings indicate that the NT–RY–WB agricultural practice has great potential for SOC sequestration and net GWP reduction, making it an environmentally beneficial agricultural system for mitigating climate change in Asia's organic food production.

Track: 2023 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

Evaluating Soil Erosion and Runoff Dynamics in a Humid Subtropic, Low Stream Order, Southern Plains Watershed from Cultivation and Solar Farm Development

Authors: *Luis Mier-Valderrama (Texas A&M University-Kingsville); Benjamin Turner (Texas A&M University-Kingsville)**

Much has been done to improve soil and water conservation where agriculture has driven land use intensification. Less is known about soil- and water-related impacts from intensification driven by solar farming, especially at watershed-scales. Here we employed Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) to model Pond Creek, a rural watershed in Texas, USA. Land use is primarily crop cultivation and secondarily pasture for cattle grazing. Presently, several industrial-scale projects are planned to convert ≈15-30% of Pond Creek from agriculture to solar farms. The model was parameterized using public data sources (USDA, USGS) and information from local stakeholders, then calibrated to several historical precipitation events. Experiments were conducted by varying precipitation depth, duration, and land uses: native vegetation pre-cultivation (control), current cultivated conditions (current), current conditions with 15% solar farm conversion (solar), and current conditions with 30% solar farm conversion (solar x2). Cumulative sediment load significantly increased when land shifted from current to solar or solar x2 treatments, although peak discharge rate differences were not significant. Comparison to soil loss tolerance values showed current and solar treatment erosion rates exceed inferred soil generation rates. All treatments were significantly different from the native control, illustrating long-term shifts in watershed functions. We discuss high leverage strategies likely applicable to solar farm sites as well as whole watersheds where they reside. With accelerated demand for rural solar farm development, greater attention is warranted from the soil and water conservation community to better prepare for the impacts such changes will have across working landscapes.

Track: 2023 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

If We Know Groundwater Is a Limited Resource that Must Be Managed, Why Are Water Tables in Texas Continuing to Decline?

Authors: *Julianna Leal (Texas A&M University-Kingsville); Benjamin Turner (Texas A&M University-Kingsville)**

Across Texas, aquifer levels are stressed due to various growing demands over time, which isn't expected to change given population growth. Groundwater levels are declining faster than average recharge rates, which pose serious problems such as land subsidence in urban/municipal areas, reduction in shallow groundwater retransmission to creeks and streams critical for riparian and riverine ecosystems, higher pumping costs or complete loss of water sources for agricultural production. Change in groundwater levels are complex functions based on geologic, environmental, and economic factors, such as precipitation-driven recharge or over-excessive pumping. No particular stakeholder is responsible given pumping is used by agricultural, municipal and industrial sectors. Using a mix of publicly available data for Texas, trends and patterns over time in hydrologic, social, agricultural, and economic factors were examined to understand groundwater resources in relation to land surface changes. We developed a causal loop diagram (CLD) to visualize feedback processes between key variables and the influences they have on another. For example, farmers rely on crop production for income. Water for crop production comes from two sources: precipitation or irrigation (groundwater pumping). As precipitation depth/frequency becomes less reliable, farmers often make up the crop-water deficit through pumping. Likewise, cities source water for municipal use through surface water and groundwater, but as surface water availability shrinks, municipalities may pump groundwater to keep up with demand. As urbanization continues, it's appealing for people to relocate to areas of rapid growth; as community population grow, so does the need for water. Increased cooperation, participation from all stakeholders and reinforced scientific support for efficient water management can aid in sustainable groundwater resources and correct declining aquifer levels in Texas.

Track: 2023 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

Nitrate Leaching and Crop Yield for Intermediate Wheatgrass (Kernza®) in the US Midwest

Authors: *Gurparteet Singh (University of Minnesota)**

Nitrogen fertilizer application is critical to high input annual grain crops including maize (*Zea mays* L.) and also positively impacts crop yield. Hence, growers tend to increase N application rates far above the amount required by the crop. As a result, the excess N gets leached below ground in the form of nitrate-N making agricultural N fertilizer application one of the major causes of nutrient pollution in surface and subsurface waters. Optimizing N application rate and timing have the potential to significantly reduce nitrate-N leaching. Additionally, perennial cropping systems with larger and denser root biomass, including intermediate wheatgrass, have shown to reduce N leaching while not significantly impacting IWG yields. Soil water nitrate concentrations from intermediate wheatgrass (IWG) and business as usual (BAU) cropping systems are compared for preliminary data from first growing season of the study. The impact of different fertilizer rates and timings is also being observed on both cropping systems. Findings from this research can potentially aid in the development of cropping strategies that reduce nitrate-N pollution, while continuing to produce high yield crops..

Track: 2023 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

A Modeling Assessment of Agricultural Land Groundwater Recharge in the Kaweah River Watershed, California

Authors: *Hoori Ajami (UC Riverside); Juan Acero Triana (UC Riverside); Yusen Yuan (UC Riverside); Sandra Armengol (UC Riverside); Eric Wineteer (UC Riverside); Ray Anderson (USDA-ARS); Jason Kelley (USDA-ARS); Dong Wang (USDA-ARS)**

Sustainable management of agricultural ecosystems is a great challenge in the 21st century because of the increasing demand for food production and decreases in freshwater availability. Groundwater accounts for 40% of water withdrawals in irrigated agriculture, and groundwater depletion in major aquifers impacts the sustainability of agricultural production. Therefore, quantifying groundwater recharge and plant water use is of great importance for sustainable water management in agroecosystems and maximizing irrigation efficiency. In the mountain-valley aquifers such as the Kaweah River watershed in the southern Central Valley California, mountain system recharge is a major component of recharge. Our recent study using geochemical data revealed that mountain block recharge is the primary natural recharge pathway in the watershed. This result contradicts the results of an integrated groundwater-land surface model of the watershed that showed higher mountain front recharge (streamflow infiltration at the mountain front). In this study, we updated our conceptual geological model of the Kaweah River watershed to characterize major hydrologic pathways using ParFlow.CLM. Preliminary results showed that for this watershed, mountain front recharge is the primary, and mountain aquifer recharge is the secondary pathway of groundwater recharge. Furthermore, we conducted three major field campaigns in two citrus orchards in the watershed to partition evapotranspiration (ET) fluxes between soil evaporation and plant transpiration using the flux variance similarity approach and isotope-based ET partitioning methods. Field results showed that plant transpiration was higher during mid-day and equal or less than 50% of ET in early morning and late afternoon or evening. These data help to constrain vegetation parameters in the ParFlow.CLM model of the watershed. Our results are expected to greatly improve the characterization of ecohydrologic processes of the mountain-valley aquifer system. The findings are valuable for growers and groundwater sustainability agencies to formulate sustainable and effective groundwater management practices in highly managed agroecosystems.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Assessing Conservation Practice Impacts on Reducing Soil Loss from Ephemeral Gullies within CEAP Watersheds

Authors: *Ronald Bingner (USDA-ARS)*; Eddy J Langendoen (USDA-ARS); Martin Locke (USDA-ARS); Robert Wells (USDA-ARS); Dalmo A. N. Vieira (USDA-ARS); Lisa Duriancik (USDA-NRCS)*

Soil erosion by water on cropland has decreased approximately 30% between 1982 and 2017, as shown by the 2017 National Resource Inventory (NRI). However, the NRI only considers sheet and rill erosion in these estimated soil erosion rates, with very few studies attempting to understand and quantify soil loss from ephemeral gullies (EG). Thus, the Natural Resources Conservation Service (NRCS) is not receiving enough credit for reducing soil loss around the US. EG has been identified in CEAP watersheds in Iowa, Kansas, Maryland, Mississippi, Ohio, Oklahoma, and Vermont, and have been observed in many more. However, soils within CEAP watersheds have not been fully characterized to determine how much soil loss results from EG nor the extent to which EG occurs within the watersheds. Further, no studies have quantified or evaluated the impact of conservation practices on reducing EG erosion (EGE) in CEAP watersheds. This project quantifies EGE in Maryland and Mississippi CEAP watersheds, identifies vulnerable areas within the watersheds, and assesses the impacts of conservation practices on EGE reduction. Data collected on the study areas involves soil samples to assess soil property effects on EG formation and soil loss, along with providing databases describing climate, practices, and runoff and sediment observations of the study sites. Riparian buffer practices were shown to reduce EGE in both Maryland and Mississippi watersheds using erosion prediction technologies. By identifying the appropriate type of conservation practices to the erosion source, practice placement can be targeted to achieve the greatest impact on the amount of soil saved from the entire system.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Assessing the Field and Watershed Scale Impacts of Conservation Practices in the Blanchard River Watershed

Authors: *Laura Johnson (Heidelberg University)*; Nathan Manning (Heidelberg University); Jay Martin (Ohio State University); Kevin King (USDA-ARS)*

Over the past two decades, the western basin of Lake Erie has been experiencing re-eutrophication with some of the largest harmful algal blooms (HABs) in the past 11 years. The HABs in Lake Erie are closely associated with dissolved phosphorus (P) loading from Maumee River from March to July and the primary source of this loading is row crop agriculture. To reduce bloom severity, a target 40% reduction in total and dissolved P loads from the Maumee River was set in 2015. Current modeling results indicate that this target will be very difficult to reach using common conservation practices, especially for dissolved P. In the Lake Erie region, water quality monitoring of tributaries to the lake is very robust and edge-of-field monitoring evaluating the effect of conservation practices is well-established, but few studies combine these approaches. Therefore, we began a study on a pair of small watersheds (<10,000 acres) in the headwaters of the Maumee River in 2018 to scale-up the effect of conservation practices. In each watershed, a minimum of one sample per day and, during storm runoff, up to three samples a day are analyzed for all major nutrients and suspended sediments. Following two years of monitoring, we found that nutrient loads relative to discharge were similar between the paired watersheds and began prioritized EQIP funded implementation of conservation practices in the treatment watershed in 2020. In collaboration with The Ohio State University and many partners, this project is being expanded in fall 2023 to enhance implementation of conservation practices to over 70% of the treatment watershed. Building on this effort, an edge-of-field monitoring location in the treatment watershed was added in the fall of 2022 and upstream monitoring locations were added in spring 2023. Results from this project will help quantify the needed investment in conservation practices to reduce P loads and ultimately improve the health of Lake Erie.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Conservation Effects Assessment Project in Northeast Arkansas

Authors: *Michele Reba (USDA-ARS)*; Niroj Aryal (North Carolina A&T University); Geoffrey Payne (USDA-ARS)*

Non-point source pollution due to agriculture is the leading source of water quality impairment in U.S. water resources. Nutrients and sediment lost in runoff from agricultural fields can impact water quality in downstream waterways. In an effort to better understand the impact of how conservation practices impact water quality, two watersheds were identified as Conservation Effects Assessment Projects in 2014 in northeast Arkansas. Generally, one watershed was dominated by a cotton-soybean rotation (Little River Ditches (LRD)) and the other a rice-soybean rotation (Lower St. Francis (LSF)) and both were irrigated primarily with groundwater. Data collection continues at LRD, but was discontinued in LSF in 2022 due to a lack of collaborator interest and support. A new watershed was established in early 2023 in an area dominated by rice-soybean rotation that is irrigated with a mix of both groundwater-surface water. In both watersheds, water samples are collected, discharge is measured, and water quality sondes deployed at five locations.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Discerning and Mitigating Legacy N Sources in CEAP Watersheds through Measurement and Modeling

Authors: *Cathleen J. Hapeman (USDA-ARS); Dylan Owen (USDA-ARS); Greg W McCarty (USDA-ARS)*; Teferi Tsegaye (USDA-ARS); Lisa Duriancik (USDA-NRCS); Michael White (USDA-ARS); Ryan Bailey (Colorado State University); Jeff Arnold (USDA-ARS); Clifford Rice (USDA-ARS); W. Dean Hively (USGS); Pamela Rice (USDA-ARS); John M Baker (USDA-ARS); Oliva Pisani (USDA-ARS); Claire Baffaut (USDA-ARS); Troy Gilmore (University of Nebraska); Robert Malone (USDA-ARS); Stephen Hamilton (Michigan State University); Laura Johnson (Heidelberg University); Kevin King (USDA-ARS); Anthony Buda (USDA-ARS); Joshua Faulkner (University of Vermont); Dennis Busch (Water Resources Monitoring Group LLC)*

Nitrogen export from agricultural lands is a challenging watershed conservation problem to address due to uncertain nitrogen use efficiencies, complicated movement and biogeochemistry of N in groundwater systems, and confounding influences, i.e., engineered hydrology, weather inputs, and agronomic practices. Advances in the nutrient science and management have improved the understanding and efficacy of national watershed conservation programs. But critical to understanding overall agriculture N loads to various waterbodies and watersheds is determining the contribution of legacy N (prior applied N) and its delayed delivery (lag time) to the edge of field and to watershed loads, all of which are poorly understood and are typically estimated. This information is also needed for assessing conservation practices effects on the annual loads to watershed ecosystems. The overall goals of the Conservation Effects Assessment Project (CEAP) Legacy N Project are to identify the sources of legacy N in fields and watersheds and to assess conservation options to capture and treat these sources. Researchers will leverage the USDA Watershed Lag Time Project (WLTP) results and will obtain additional data from point in time stream sampling and from land use and land characteristic databases of selected watersheds, synthesize the data streams, and examine the variance of input sources and the possible factors affecting delivery of legacy N. These data and process information will be utilized by the SWAT+ (Soil and Water Assessment Tool) modeling team to improve the algorithms and assumptions concerning groundwater transit times throughout the U.S. Finally, throughout the project, the team will consult regularly with the CEAP Legacy P and CEAP Legacy Sediment teams to coordinate efforts to maximize synergies, to share data streams on one platform, and to address competing processes in nutrient delivery so that a more holistic understanding and simulation of processes will be advanced.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Effective Conservation Practices for the Southeastern United States

Authors: *David D Bosch (USDA)*; Tim Strickland (USDA); Alisa Coffin (USDA); Oliva Pisani (USDA); Kathryn Pisarello (USDA)*

Over the last twenty years of the Conservation Effects Assessment Project (CEAP) significant advances have been made concerning our understanding of the effectiveness of conservation practices in the Southeastern United States. Research conducted by the Southeast Watershed Research Lab (SEWRL) of the USDA-Agricultural Research Service quantified the benefits of conservation tillage, nutrient management, winter covers, and riparian buffers. SEWRL research indicates: (1) conservation tillage can reduce surface runoff by 35%, sediment loss by 87%, surface nutrient loss by 33%, nitrate-N leaching by 13%, pesticide loss by up to 80%, and total organic carbon loss by 46%, (2) conservation tillage can improve plant N availability by 27 kg ha^{-1} yr^{-1}, (3) riparian buffers attenuate the delivery of runoff, sediment, nutrients, and pesticides, and (4) models can be used to identify areas where conservation practices will be most effective. Research in coastal areas of Puerto Rico indicated that riparian areas there have the potential to reduce pesticide transport in surface runoff by 37 to 77%. SEWRL field and watershed data have been used to develop, test, and improve the APEX and SWAT models, further advancing CEAP goals. Geographical information systems have been used to map out conservation practices across the region and quantify potential impacts of these practices. Each of these efforts have aided in the advancement of conservation efforts across the region. Long-term research on conservation practice effectiveness is critical for capturing the impacts of climatic variability. All data collected by the SEWRL for the CEAP projects are publicly available.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Evaluating Conservation Practice Effects at the Watershed- and Field-Scales in the Lake Champlain Basin of Vermont

Authors: *Joshua Faulkner (University of Vermont)*; George Myers (University of Vermont)*

Agricultural phosphorus contributions to water quality degradation are a significant concern within the Lake Champlain Basin (LCB) of Vermont. A paired-watershed Conservation Effects Assessment Project (CEAP) Watershed study was initiated in 2019 to evaluate the effects of agricultural conservation within the LCB. Continuous flow data, baseflow, and storm event nutrient concentrations have been collected in three agriculture-dominated tributaries since early 2020. The study transitioned out of the calibration period into the treatment period in early 2023. An analysis of water quality data collected thus far will be presented, including results of an investigation of the importance of winter nutrient loadings to annual watershed nutrient contributions. Preliminary findings indicate that approximately 60% of P loadings are in the dissolved form. In addition to the watershed-scale study, an associated CEAP Stacked Practices and Innovative Phosphorus Removal project was initiated at the field-scale in 2021. The study will evaluate the 'stacking' of multiple conservation practices at the field-scale, using a paired-watershed study approach. This study has also been evaluating performance of phosphorus removal technologies at the edge-of-field. Preliminary findings indicated that Soluble Reactive P concentrations have been reduced by over 90% for one installation. Results of surface and subsurface monitoring from study fields will be presented.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Examining the Prospects for Short-Range Runoff Forecasting in the Mahantango Creek Watershed Using a National Weather Service Hydrologic Model

Authors: *Anthony Buda (USDA-ARS)*; Seann Reed (NOAA-NWS); Gordon Folmar (USDA-ARS); Casey Kennedy (USDA-ARS); David Millar (USDA-ARS); Peter Kleinman (USDA-ARS); Douglas Miller (Penn State University); Patrick J. Drohan (Pennsylvania State University)*

Runoff forecasting with hydrologic models has the potential to offer important insight into rainfall-runoff events that can transfer recently applied nutrients to runoff waters. Such forecasts, if they were accurate and reliable, could enhance operational decision making by farmers around when to apply nutrients to fields. This presentation draws on a recently published study that examined whether a National Weather Service (NWS) hydrologic model could simulate and forecast runoff in Mahantango Creek, a benchmark CEAP watershed operated by USDA-ARS since 1968. Briefly, we calibrated the model against fifteen years (2004–2017) of runoff data in the broader Mahantango Creek watershed (area = 420 km^2) as well as in WE-38, an interior headwater basin (area = 7.3 km^2). Results of the historical calibration showed that runoff simulations in Mahantango Creek and in WE-38 had low to moderate biases and strong agreement with observations. Using the calibrated model, we then conducted a series of forecasting experiments in both watersheds to evaluate the quality of short-range (one to three days ahead) deterministic runoff forecasts over a two-year period (July 2017– October 2019). Simple persistence, which assumes that future runoff amounts will be the same as current observations, was used as the reference forecast for judging forecast skill (relative accuracy). Notably, we found that the model produced highly skillful runoff forecasts at all lead times and significantly outperformed persistence forecasts. Future research will evaluate longer lead times (five to seven days ahead) and the use of ensemble forecasting to assess forecast uncertainty.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Impacts of Conservation Practice Implementation on Water Quality, Soil Quality, and Stream Ecology in Ohio

Authors: *Kevin King (USDA-ARS)*; Rocky Smiley (USDA-ARS); William Osterholz (USDA-ARS); Jedediah Stinner (USDA-ARS); Kathryne R. Rumora (USDA-ARS)*

Eutrophication continues to be a primary concern in the humid, artificial tile-drained region of the Eastern Corn Belt. Both nitrogen and phosphorus loss from agricultural crop production have been linked to the extent and toxicity of the recurring algal blooms within Lake Erie as well as affecting ecosystem function in other local waterbodies. Understanding the transport mechanisms and identifying practices to address eutrophication are important in guiding voluntary, incentive and regulatory based efforts. A combination of plot, field, and stream-scale research is being used to isolate and understand the governing processes that control the hydrologic, water quality, and ecological responses as well as assessing existing and novel management and conservation practices for their ability to reduce nutrient loss, enhance stream habitat and increase aquatic biodiversity. In field practices such as cover crops and edge-of-field practices such as drainage water management significantly reduced subsurface nitrate losses but findings with respect to phosphorus were not well defined. Further preliminary findings suggests that there was no definitive positive relationship with soil health and water quality. Finally, improvements in physical habitat quality and water quality within agricultural ditches and streams will benefit fishes and amphibians. These findings should be important to producers, crop advisors, extension specialists, researchers, and conservationists as well as local, state, and federal action agencies.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Mitigation of Excess Legacy Soil Nutrients on the Delmarva Peninsula Using Perennial Grasses

Authors: *Greg W. McCarty (USDA-ARS)*; W. Dean Hively (USGS); Cathleen Hapeman (USDA-ARS); Gurpal Toor (University of Maryland); Nicole Fiorellino (University of Maryland); Maryam Foroughi (USDA-ARS); Lisa Duriancik (USDA-NRCS)*

Legacy accumulations of agricultural nutrients are known to contribute to harmful algal blooms. In the Chesapeake Bay watershed, agricultural nutrients are greater than crop production needs due to accumulated P from the historical application of dairy manure and poultry litter. Perennial biomass crops have been promoted for excess nutrient mitigation due to their living roots year-round, lower fertilizer requirements, and harvested biomass removal. Miscanthus × giganteus is a productive, sterile perennial grass with particular local utility as an on-farm source of poultry bedding. This project compares water and soil nutrient concentrations in conventional row crop fields and unfertilized M. × giganteus buffers harvested in winter for use as poultry bedding. Sampling locations were instrumented with piezometers (150 cm and 200 cm), suction lysimeters (30 cm, 60 cm, and 90 cm), and resin lysimeters (30 cm below soil surface) to monitor nutrient dynamics in M. × giganteus buffers and adjacent row crop fields (corn and alfalfa) on two cooperating farms. Project goals are to: 1) assess the effect of perennial grass bedding production on farm nutrient cycling, 2) quantify air emissions from poultry houses using grass bedding versus traditional sawdust bedding, 3) examine the effects of composting used bedding for use on-farm or as a consumer product, and 4) life cycle and economic analyses. Another aspect of this project is to determine how best to control M. × giganteus to ensure it does not become invasive to adjacent non-field habitats. Current observations indicate that it maintains sterility and does not creep beyond planted boundaries, although tillage and erosion could mobilize rhizomes. These concerns are offset by the clearly positive environmental impact of reduced fertilizer use in watersheds with substantial cropland devoted to the production M. × giganteus with low nutrient requirements.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

National Food and Agriculture (NIFA) Conservation Effects Assessment Project (CEAP) Watershed Synthesis Study: Lessons Learned Still Informing Effective Conservation

Authors: *Deanna Osmond (North Carolina State University)*; Lisa Duriancik (USDA-NRCS)*

The NIFA CEAP watershed study synthesized lessons learned from 13 agricultural watershed projects located across the United States. Some of the insights were also previously documented as recommendations following programs prior to CEAP. Although the major lessons learned are over ten years old, they are still pertinent for current agricultural watershed projects and to our understanding of reducing nonpoint source losses. These lessons, which range from identifying the specific constituent of concern and it's critical source area, then matching the appropriate conservation practice type and spatial application to providing farmer-based education and trusted advisors, are as relevant in 2023 as they were in 2012. How to Build Better Agricultural Conservation Programs to Protect Water Quality: The NIFA-CEAP Experience book is still available from Soil and Water Conservation Society as an open-access publication (https://www.swcs.org/resources/publications/how-to-build-better-agricultural-conservation-programs-to-protect-water-quality). There are also fact sheets (https://cals.ncsu.edu/crop-and-soil-sciences/extension/publications/) outlining the major lessons learned and many presentations from the NIFA CEAP watershed synthesis study that are still useful and relevant. Lessons learned have been applied to some degree in conservation and watershed programs. However, agencies are still working to adapt program implementation and planning processes to improve effectiveness and more fully implement lessons learned to improve conservation's contribution to improved watershed outcomes.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Nutrient Dynamics after Simulated Flooding of Soils and Sediments from Conservation and Agricultural Land-Uses in Beasley Lake Watershed, A CEAP Watershed in the Mississippi Alluvial Plain

Authors: *Lindsey Witthaus (USDA-ARS)*; Ethan Pawlowski (USDA-ARS); Jason Taylor (USDA); Martin Locke (USDA-ARS); Richard E. Lizotte (USDA); Lucas Heintzman (USDA-ARS); Matthew Moore (USDA)*

Inundation of soils and sediments can alter redox properties, and microbial content, and induce nutrient transformations leading to changes in nutrient fluxes. Soils located in the agriculturally rich Mississippi River Alluvial Plain have medium to high phosphorus (P) content and may experience long periods of saturation followed by drying, as well as periods of inundation due to flooded conditions. In Beasley Lake Watershed, Mississippi, we assessed potential P and nitrogen (N) fluxes that may occur when dry soils are seasonally re-wetted and remain submerged in water for various residence times. Soils were collected from two locations within five habitats: cropland, Conservation Reserve Program land (CRP), riparian wetland, sediment retention pond (SRP), and drainage ditches. To simulate flooding, samples were inundated with water, and replicates were incubated at 5, 15, 25 and 30°C to represent different seasonal temperatures throughout the year. Water was sampled at 4, 8, 12, 24 and 48 hours to evaluate nutrient fluxes. Preliminary results showed phosphate releases increased with increasing temperature, ammonia releases increased up to 25°C and then decreased, and nitrate releases generally decreased with increasing temperature. Overall, first-flush phosphate and nitrate releases were highest in the dry riparian habitat, cropland, and ditch sites, and lower in CRP and SRP sites. These results can be combined with other data to establish baseline estimates of potential fluxes during a flooding event across the watershed. Flooding has become more frequent in this watershed with major flooding events affecting 75, 87, and 102 ha of CRP, forest, and cropland, respectively. As many areas of this region experience recurring major floods due to overbank flow and backwater, these results may clarify the role of these extreme events in altering nutrient dynamics across habitats.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Reducing Sediment and Phosphorus Losses in a Small Watershed by Converting from Surface to Sprinkler Irrigation

Authors: *David Bjorneberg (USDA-ARS)*; James Ippolito (Colorado State University); Anita Koehn (USDA-ARS); Sayjro K. Nouwakpo (USDA-ARS); Christopher Rogers (USDA-ARS); Isis Scott (USDA-ARS)*

Water flowing over soil during surface irrigation can detach and transport sediment and nutrients. Runoff is often planned with surface irrigation to improve infiltration uniformity between the inflow and lower ends of fields. The primary conservation practice in surface irrigated watersheds is conversion from surface to sprinkler irrigation. Water quality was measured in a 200 ha irrigated watershed that changed from 95% surface irrigated in 2005 to 15% surface irrigated in 2017. Total runoff from the watershed has not changed during this time period primarily due to the flow rate allocation of irrigation water and supply-based design of the irrigation project. Sediment and phosphorus losses from individual fields were greatly reduced or eliminated by converting to sprinkler irrigation. Water quality at the watershed scale, however, did not substantially improve until 2017 when 85% of the watershed was sprinkler irrigated. Peak sediment loads exceeded 20,000 kg/day until 2016 and have decreased to less than 2,000 kg/day from 2017 to 2020. Runoff from a single surface irrigated field can impact the overall water quality at the watershed outlet, which occurred when an 8-ha field near the outlet increased sediment concentrations 10-fold. Surface irrigated fields that are not converted to sprinkler irrigation need practices installed to control erosion, contain runoff or trap sediment on the field.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Saturated Riparian Buffers as Promising Edge-of-Field Conservation Practice

Authors: *Natalia Rogovska (USDA-ARS NLAE)*; Kevin J. Cole (USDA-ARS NLAE); Sheela Katuwal (USDA-ARS NLAE); Gabriel M. Johnson (Iowa State University); Robert Malone (USDA-ARS); Dan Jaynes (USDA-ARS); Thomas Isenhart (Iowa State University)*

Excessive nitrate in surface waters is a key factor causing degradation of water quality locally and a major cause of the hypoxic zone in the northern Gulf of Mexico. Numerous conservation practices have been proposed to reduce nitrates entering streams including in-field practices such as fertilizer management or cover crops implementation; and field-edge practices, such as bioreactors. A saturated riparian buffer is a novel field-edge practice developed to remove nitrates from artificial subsurface drainage before it reaches surface waters by diverting tile water into riparian buffer soil via shallow distribution pipes. As diverted drainage infiltrates from the distribution pipe into the buffer soil, nitrate is removed primarily by denitrification and plant uptake. Saturated buffers were shown to remove an average of 63.7 ± 65.9 kg N/y (n = 47 site-years across Iowa, Illinois, Indiana, and Minnesotan). In addition, the percentage of nitrate-N removed from diverted flow averaged 82 ± 22% across 29 site-years in Iowa and Illinois. The nitrate removal efficiency variance can be explained by numerous factors impacting saturated buffer performance including site design, soil characteristics, and climatic condition. Overview of the past studies in Iowa and other states and current research and outreach activities related to saturated buffer performance within the South Fork of the Iowa River watershed will be presented.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Significant Findings from the CEAP Goodwin Creek Experimental Watershed

Authors: *Ronald Bingner (USDA-ARS)*; Roger Kuhnle (USDA-ARS); Eddy J. Langendoen (USDA-ARS); Andy O'Reilly (USDA-ARS); Robert Wells (USDA-ARS); Dalmo A.N. Vieira (USDA - Agricultural Research Service); Daniel Wren (USDA-ARS)*

The Goodwin Creek Experimental Watershed (GCEW) is one of the original CEAP ARS Watershed Assessment Studies Benchmark watersheds located in the uplands of north-central Mississippi. This 20.3 km^2 watershed was chosen for its mixed land-use, active upland erosion and steep degrading channels with unstable banks. The watershed is a tributary of the Yazoo River, which ultimately flows into the Mississippi River. There have been several major findings from CEAP studies on GCEW. The in-stream structures at several locations in GCEW have reduced total and fine sediment yields with reductions ranging from 10% to 70%. These structures had a greater impact on sediment yields and bank stability in the upstream portions of the watershed. The land-use shift of cropland to forest and pasture from the 1980s to the present can be attributed mainly to adoption of Cropland Reserve Program (CRP) conditions that resulted in sediment concentrations decreasing from 3,000 to 1,000 ppm demonstrating long-term control of sediment. This large land use shift also included CRP forest riparian buffer implementation along 47.5 miles of stream channels that resulted in a 60% sediment reduction within GCEW that was also shown to vary by particle size: 38% for clay, 62% for silt and 70% for sand. Most (78%) of the fine sediment reaching the GCEW outlet were derived from channel sources demonstrating that total watershed erosion control requires consideration of concentrated flow sources from channels and gullies. Field ponds reduced the annual average runoff volume by 4% and the average peak flow by 36%.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Sugarcane and Flooded Rice Crop Rotation Effects on Soil and Water Quality within the Everglades Agricultural Area

Authors: *Jehangir H. Bhadha (University of Florida)*; Yuchuan Fan (University of Florida); Xue Bai (University of Florida); Fatemeh Maghsood (University of Florida); Young Gu Her (Department of Agricultural and Biological Engineering/Tropical Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida); Samuel Smidt (University of Florida)*

In the Everglades Agricultural Area (EAA) of South Florida, farming practices have long been mindful of phosphorus (P) management as it relates to the sufficiency and efficiency of P utilization. Research is being conducted on organic soils to improve the efficiency of nutrient uptake and minimize discharge loads. During the summer, more than 50,000 acres of fallow sugarcane land is available for rice production. With no starter fertilizer (N, P, K) applied, rice cultivation can potentially function as a sink for nutrients because of particulate settling and plant uptake, while harvested whole grain rice can effectively remove nutrients from a rice field per growing season. As part of a long-term Conservation Effects Assessment Project, a diverse team of researchers are working towards evaluating the effects of rice in rotation with sugarcane on soil and water quality. Water quality parameters including total P, and N and total suspended solids, and soil health indicators such as organic matter, active carbon, total P, and total Kjeldahl N will be used as part of the assessment. Preliminary results show that under flooded rice conditions, Eh and DO were 336.7 ± 107.1 mV and 5.84 ± 2.71 mg/L respectively, indicating an aerobic condition. Under the rice production system, from Feb 2022 to Oct 2023, the mean TN content in groundwater, ditchwater, and canal was 9.162 ± 3.151 mg/L, 2.647 ± 0.231 mg/L, and 2.488 ± 0.274 mg/L, respectively; and the mean TP content in groundwater, ditchwater, and canal was 0.352 ± 0.042 mg/L, 0.059 ± 0.005 mg/L, and 0.069 ± 0.009 mg/L, respectively. Modeling efforts involve calibration of the integrated modeling tool to groundwater level, canal water level, and water quality parameters observed at the study fields. Plans to leverage emerging results to scale up geospatially will include analyzing EAA sugarcane production and conservation impacts relative to other regions in the United States.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

The Agricultural Conservation Planning Framework (ACPF) Enhancement Project

Authors: *John M. Baker (USDA-ARS)*; Sarah Porter (USDA-ARS); David James (USDA-ARS National Laboratory for Agriculture and the Environment)*

The Agricultural Conservation Planning Framework (ACPF) has proven to be an effective tool for identifying conservation opportunities within Midwestern agricultural watersheds. With the establishment of the ACPF National Hub, there has been a growing interest in expanding the ACPF into new geographic regions as well as including additional best management practices (BMPs). A NRCS/CEAP-funded ACPF enhancement project has resulted in the addition of two new tools into the ACPF Toolbox: the soil vulnerability index (SVI) and two-stage ditches. The incorporation of high-resolution topographic information into the SVI has greatly increased its applicability beyond the traditional map unit-based approach. The riparian assessment feature within the ACPF was leveraged to determine the suitability of stream sections and their associated riparian zone for construction of two-stage ditches. These tools have been applied in ten CEAP research watersheds to assess their applicability across vastly different agricultural landscapes. This effort has achieved collaboration between NRCS, ARS, and CEAP scientists, and presents a pathway for technology transfer of agricultural research into practical tools to engage landowners and bridge the gap between field-scale and area-wide planning.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

Watershed Legacy Sediment Assessment

Authors: *Eddy J. Langendoen (USDA-ARS)*; Ron Bingner (USDA); Martin Locke (USDA-ARS); Rob Wells (USDA-ARS); Daniel Wren (USDA-ARS); Lisa Duriancik (USDA-NRCS)*

Identifying the causes and implementing appropriate solutions for excessive sediment loading has proven challenging because a multitude of natural and anthropogenic factors influence erosion and sediment delivery. In agricultural landscapes, excessive sediment loading has been documented from cultivated lands, but an increasing body of literature is demonstrating that fluvial channel erosion can also be a dominant sediment source and high sediment loadings are better explained by recruitment of anthropogenic (i.e., legacy) sediment from floodplains or impoundments than from cultivated lands. Hence, improving our ability to identify and document the sources of sediment within watersheds is essential to helping us design and implement effective restoration and conservation strategies within watersheds, including within the stream network itself, and to address sediment sources, including legacy (or historical) sources of sediment. The CEAP Special Project entitled "Watershed Legacy Sediment Assessment" was funded beginning Fiscal Year 2023 with three specific year-1 goals: (1) Explore and enhance tools used to identify and document sources of legacy sediment in agricultural watersheds; (2) Characterize legacy sediment erosion and delivery processes within two CEAP study watersheds; and (3) Enhance process understanding of nitrogen and phosphorus remobilization in legacy sediment for more effective restoration strategies. Expected outcomes of the Special Project are: (1) Better representation of legacy sediment in models; (2) Improved understanding of the potential for conservation practices to improve water quality by mitigating legacy sources of nitrogen, phosphorus, and sediment; and (3) USDA conservation practices and programs become more effective at producing watershed outcomes.

Track: 2023 General Conference Theme

Subject: CEAP Showcase

An Innovative Approach for Invasive Species Targeting and Control Using Remotely Sensed Data and Techniques within the Chickasaw Nation Treaty Territory

Authors: *Mark Micozzi (The Chickasaw Nation)*; Justin Baker (Aqua Strategies)*

The Chickasaw Nation, in partnership with Aqua Strategies, the Oka' Institute at East Central University (ECU), Oklahoma State University (OSU) and the Natural Resources Conservation Service (NRCS) will develop an innovative approach using a suite of remotely sensed data and techniques to optimize efforts to identify and clear eastern redcedar trees within the Chickasaw Nation treaty territory. Currently, eastern redcedar, *Juniperus virginiana*, is increasing in density and range, negatively affecting both agricultural productivity and water recharge of aquifers and surface water bodies. Prescribed fire has proven to be a very effective tool in slowing this growth, but this method is less effective on very sparse or very dense, well-established stands. Therefore, this project will identify the range of tree density and median tree age that will be optimal for prescribed burns and create a system by which land parcels can be efficiently prioritized for cedar clearing. By applying this remote sensing-based methodology, the Chickasaw Nation will be able to restore productivity of agricultural ranchland more quickly and economically, while also improving water quality, availability and aquifer recharge conditions. The data and methodology used for this project will be transferred to the NRCS as an enhancement to the Rangeland Analysis Platform (RAP). Ultimately, the long-term goal of this project is to provide positive impacts to landowners, streams, lakes and aquifers and potentially provide a tool that can be applied in other parts of the country.

Track: 2023 General Conference Theme

Subject: CIG Showcase

An Internet of Things (IoT) System to Monitor Soil Moisture and Improve Irrigation Water Management

Authors: *Jose O. Payero (Clemson University)*; Udayakumar Sekaran (Oregon State University)*

The use of soil moisture data to make irrigation decisions in commercial farming is very limited, partially due to the lack of affordable monitoring systems to collect and transmit data in real time. The objectives of this project were to (1) evaluate the use of an affordable Internet of Things (IoT) soil moisture monitoring system in commercial farms in South Carolina and (2) evaluate the economic benefits of using the IoT monitoring technology. A three-year project funded by the NRCS was initiated in 2020 using an IoT soil moisture monitoring system developed at Clemson University. The system uses low-cost open-source electronics, cell phone communication, and IoT technologies to collect soil moisture data and send the data to the Internet in real time. Farmers can visualize the data using a computer or cell phone and use the information to make irrigation scheduling decisions. From 2020 to 2022, eighteen on-farm trials were conducted on farmer's fields planted to row crops (i.e., corn, cotton, peanuts, or soybeans) in South Carolina. In each farm, two adjacent irrigated fields were selected, one instrumented with sensors (sensor field) and the other without sensors (companion field). The farmers irrigated the sensor field based on the sensor data and the companion field following their usual irrigation practice. Agronomic and economic data were obtained to compare the economic impact of the two irrigation options. Our results showed that, with a few exceptions, the sensor fields had higher net income than the companion fields. For example, the combined data for 2020 and 2021 showed that the sensor fields had an average increase in net income of around 11%. Based on these results, future efforts should be directed at educating the farmers via Extension activities to demonstrate the benefits of the technology. More research should also be conducted to develop more affordable and reliable sensing and data communication technologies adaptable to remote rural areas.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Biocarbon-Driven Dairy Manure Management Demonstration for Enhanced Water Quality

Authors: *Eunsung Kan (Texas A&M AgriLife Research Center)*; Jim Muir (Texas A&M University's Agrilife Extension); Paul DeLaune (Texas A&M AgriLife Research); Jeff Brady (Texas A&M AgriLife Research); Jennifer Spencer (Texas A&M AgriLife Extension); Caitlyn Cooper (Texas Tech); Edward Osei (Tarleton State University); Kartik Venkataraman (Tarleton State University); Barbara Jones (Tarleton State University)*

Our project is developing a biochar-assisted phytoremediation system for enhancing water quality following nutrient contamination during dairy manure application. The project integrates, microplot and field-scale experiments/demonstrations, laboratory analyses, and systematic evaluations to improve our knowledge of biochar amendment and biochar-assisted phytoremediation (BCP) on dairy manure-derived reactive N and P in soil and water. Particularly, the calcium-functionalized biochar (Ca-BC) was prepared, and applied for the fields with different soils, plants, manure application, and tillage/no-tillage. Our laboratory analysis indicated Ca-BC possessed high capacities for removal of reactive P, antibiotics, and E. coli pathogens. The field experiments (microplots) were conducted under various biochar types and loading rates, soils, crops, manure application, and tillage/no-tillage: 1) four BC options (no BC, low concentration of wood BC, high concentration of wood BC, low concentration of Ca-BC), 2) two soils (sandy, sandy loam soils), 3) three plants (Bermudagrass, sorghum-Sudan grass, maize), 4) manure application (no manure, manure), and 5) tillage/no tillage. While in-depth correlations and statistical analyses for the field experiment results are being conducted, the applications of BC and Ca-BC resulted in lower concentration of reactive P, antibiotics, and E. coli pathogens in soil and groundwater under some conditions while the beneficial effects of BC and Ca-BC on crop production were clearer in the fields with no manure application. In addition to the microplot field experiments, the runoff tests were conducted to see any runoff water quality with BC and Ca-BC. Current results showed the presence of BC and Ca-BC enhanced the runoff water quality by lowering the antibiotics and P concentration in the runoff water. We will continue to conduct the microplot and runoff experiments.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Carolina Cotton Can Conserve Soil with Cover Crops

Authors: *Bhupinder Singh Farmaha (Clemson University)*; Alan J. Franzluebbers (USDA-ARS)*

The overarching goal of this project is to (1) assist farmers in the Southeastern Coastal Plain region to adopt field-validated and proven soil-health management systems with cover crops and conservation tillage; and (2) evaluate the impact of these changes in management on soil health and farm profitability. Recent research has shown there is a strong improvement in soil-test biological activity and net nitrogen (N) mineralization with adoption of no tillage and use of multi-species cover crops. Specific objectives for this project are to: (1) evaluate the influence of cover crops and conservation tillage on soil health and weed dynamics through 'On-farm Trials' in South Carolina and North Carolina; (2) document economic returns and social barriers/drivers when using cover crops in cotton-based cropping systems; and (3) increase awareness to at least 20% of stakeholders about soil health through extension and outreach activities and facilitate the adoption of improved cotton-based cover cropping systems in the region. Improvements in soil health condition will have high relevance to fine-tune soil fertility recommendations and increase farm profits in the Southeast U.S., as farmers in the region do not use soil testing to account for residual inorganic soil N or credit N from previous legume or cover crops while making soil N fertilizer recommendations. We are working directly with several cotton growers in the Coastal Plain of South and North Carolina to demonstrate the value of cover crops and conservation tillage on profitability and sustainability. Broader impacts of the project include demonstrating the importance of field-validated and proven soil-test biological activity on farms in the region, promoting the use of multi-species cover crops, engaging the participation of leading farmers and those curious in the concepts, and delivering social benefits to society (e.g. sustaining yield with optimized fertilizer inputs to improve environmental health).

Track: 2023 General Conference Theme

Subject: CIG Showcase

Conservation at the Co-op

Authors: *Joe Otto (SWCS)**

This poster will explore the Soil and Water Conservation Society's "Conservation at the Co-op" program that leverages public dollars to encourage and support agricultural retailers to offer conservation agronomy services alongside their traditional offerings. The goals of the program are to 1) train up co-op personnel in conservation agronomy services, 2) grow the network of conservation professionals working in ag retail, and 3) make permanent these important additions to the ag retail service sector. The poster will include information about On-Farm demonstration trials happening in three Midwestern states, in partnership with six co-ops, sixty-five growers, and across over 8,300 acres of farmland.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Demonstration of the Benefits of Subirrigation Using Water Level Control Structures for Improved Agricultural Irrigation Water Use

Authors: *Zen Wilhelm (Whatcom Conservation District)*; Gabriel LaHue (Washington State University); Deidre Griffin LaHue (Washington State University); Edward James Scheenstra (Washington State University); Navdeep Singh (Western Kentucky University)*

Northwestern Washington currently faces significant water resource challenges during the summer months. Competing water demands include agricultural irrigation and in-stream flows for salmon habitat. The purpose of this 3-year ongoing project is to evaluate the performance of a seasonally adjustable water level control structure (WLC) placed in-line with a local drainage ditch. Although practiced elsewhere, this WLC serves as a test case for the practice of subirrigation in this area. If successful, it will reduce the need for surface irrigation during the summer, while increasing in-stream flows. Subirrigation effectiveness will be determined by measuring real-time vertical and lateral root zone moisture fluctuations, using multi-depth moisture sensors and ground water level probes. Spatial and temporal impacts will be compared between 5 acre treatment and control plots of field corn located directly above and below the WLC respectively. Preliminary results show an increase in vertical moisture levels of the treatment plot compared to the control plot. However insufficient lateral hydraulic conductivity of certain soil profiles may reduce practical implementation due to the drainage tile density required. The results of this project will be submitted to the Natural Resources Conservation Service (NRCS), and shared directly with local growers through targeted outreach and community events.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Evaluation of Environmental Benefits of Dairy Manure Treatment Technologies for Improving Water Quality

Authors: *Jeff Porter (Newtrient)*; Mark Stoermann (Newtrient LLC)*

New technologies, practices and innovations are important to help the dairy industry remain competitive and environmentally sensitive. Newtrient is reviewing 15 dairy related technologies associated with manure management in an effort to evaluate their effectiveness and impact on environmental factors with a focus on water quality. Newtrient is using a modified version of the process used by NRCS in evaluating Waste Treatment (conservation practice 629) innovative technologies. Depending on the technology, evaluations will last either 15 or 52 weeks. Sampling and evaluation protocols were developed for each technology to determine if it performs as reported in technology publications and how it improves water quality. To date, five technology evaluations have been completed and five are nearing completion. Completed technologies for this poster show results from forced air composting compared to traditional windrow composting systems, rotary drum composting for manure solids bedding, centrifuge waste separation for improved solids and nutrient removal, and biofiltration using compost and earthworms for tertiary treatment of manure effluent. Results show that some technologies meet or exceed expectations while others have fallen short of predicted results. This poster presentation will provide a summary of technology performance of the completed projects and preliminary results for continuing studies.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Farmer-Driven Implementation of Soil Health Management Systems Adapted to Diverse Cropping Systems in Tropical and Subtropical Island Environments

Authors: *Mitchell K. Loo (RCUH)*; Jonathan Deenik (University of Hawaii at Manoa); Tai M. Maaz (University of Hawaii at Manoa); Susan Crow (University of Hawaii at Manoa); David Sotomayor (University of Puerto Rico); Johanie Rivera-Zayas (University of Hawaii Manoa); Christine Tallamy-Glazer (University of Hawaii at Manoa); Aleric Krenz (UH Manoa TPSS); Sebastian Church (University of Hawai'i at Manoa, Crow Soil Ecology and Biogeochemistry Lab); Kristina Estrada (University of Hawaii at Manoa); Mario Lopez Pagan (University of Puerto Rico); Merolin Stevennson (University of Puerto Rico); Kenneth Kiehl (University of Hawaii Manoa)*

A history of intensive sugarcane and pineapple monoculture degraded the soils of the tropical islands that make up Hawai‘i. Our team is currently cooperating with producers to establish soil health management systems (SHMS) that implement soil health building practices tailored and adapted to our unique agroecological landscapes. A primary goal of our project is to monitor soil health trends and quantify the impact of soil management practices on soil health status. Our team has compiled a database of 567 soil samples, from which we developed a scoring function based on key soil health indicators appropriate for the assessment of tropical and volcanic soils (in alignment with those proposed by NRCS). Our database covers the large variation of soil mineralogy found across the tropics, and our function is suitable to score soil health across diverse cropping systems, soil mineralogies, and historical land use legacies. Baseline soil health scores from our network of collaborating farms ranged from 5 to 88%. Our lowest score is from an intensively-managed, high-input conventional farm, while our highest score is from an organically managed vegetable farm. Our team has also collected baseline crop yields to assess changes relative to current farmer practices at each SHMS demonstration trial. For the next phase, we will perform repeat analyses of soil health status and relative crop yields. We anticipate that our monitoring efforts will demonstrate the effects of soil health building practices and support the adoption of these practices across the range of farming systems.

Track: 2023 General Conference Theme

Subject: CIG Showcase

High Clearance Robotic Irrigation for In-Season Nutrient Management

Authors: *Kapil Arora (Iowa State University)*; Andrew Klopfenstein (Ohio State University); Daniel Andersen (Iowa State University); Scott Shearer (Ohio State University); Justin Koch (360 Yield Center); Venkatesh Ramarao (Ohio State University); John Fulton (Ohio State University); Elizabeth Hawkins (Ohio State University); Nowell Moore (360 Yield Center); Matthew Helmers (Iowa State University); Kelvin Leibold (Iowa State University)*

Applying liquid-phase nutrients in-season beyond V4 stages of corn using a newly and innovatively designed high-clearance robotic irrigator has not been researched. This collaborative project between The Ohio State University, Iowa State University, and 360 RAIN intends to demonstrate in-season application of commercial and animal nutrient sources along with water application as a unified irrigation strategy to reduce nutrient losses while improving profitability with increased corn yields.

Replicated strip trials with three treatments of Fall, Spring, and In-season application have been implemented in Spring 2023 with robotic irrigation using 360 RAIN Robotic Irrigator. In-season application, consisting of the traditional and reduced application rates of N and P are being studied in this project. Measurements are being made for nitrate-nitrogen leaching losses using liquid swine manure as nutrient source in Iowa, while dissolved reactive phosphorus losses with both runoff and leaching are being measured in Ohio using commercially available nutrients. Corn yields will be measured to evaluate the impact of this proposed strategy on profitability across treatments.

Project results intend to demonstrate that high-clearance robotic irrigation, a climate-smart technology, can reduce negative environmental impacts while increasing crop profitability, for both farmers and livestock producers. OSU and ISU will offer targeted extension on-farm demonstrations, field days, and applicator certification trainings to share results of the project. Images and video from these events will be shared via Facebook and Twitter, and through the Iowa Manure Management Action Group, potentially reaching over 10,000 farmers, livestock producers, and agricultural professionals, annually. Extension fact sheets will be developed at both OSU and ISU universities to ensure that information from the project lives on after the conclusion of the work.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Impacts of Biochar and Manure Amendments on Soil Health and Water Dynamics in Cover Cropping Systems, South Dakota

Authors: *Sutie Xu (South Dakota State University)*; Varshith Kommineni (South Dakota State University); David Clay (South Dakota State University); Anthony Bly (South Dakota State University); Mengistu Geza (South Dakota School of Mines and Technology)*

To overcome the challenges in cover cropping for row crop production in South Dakota agroecosystems, it is important to improve soil moisture conservation and soil health by utilizing sustainable management strategies. Specifically, biochar application is found improving soil functions through protecting moisture and nutrients. Manure amendments, on the other hand, can directly increase the nutrient and carbon inputs to benefit plant growth. The objective of this study is to determine the impacts of biochar and manure application on soil health and nutrient and water dynamics in row crop production systems integrated with cover crops in South Dakota. This research was started in fall 2022 for field trials establishment, initial soil sampling, soil moisture data collection, and lab incubation experiment. Further soil analysis and moisture monitoring will be continued with this project.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Low-Tech Process-Based In-Stream Structures to Increase Climate Resiliency in the Great Plains

Authors: *Jason T. Sweet (Juniper Environmental)**

Extreme weather, both rainfall events and drought, has led to water quantity and quality issues in the Great Plains. Stream erosion, aquifer depletion, decreased pasture forage quality & quantity, and reduction of quality wildlife habitat have been seen as a result. In the western states, landowners have implemented Low Tech Process Based (LTPB) structures such as Beaver Dam Analogs and Post Assisted Log structures, an approved EQIP practice, to address some of these issues. Very little research has been conducted on LTPB complexes in the Great Plains, so they are not promoted, despite their potential. This study aims to evaluate the performance of LTPB complexes in Great Plains' prairie streams. The study will compare results of tests on water quality, depth to water table, riparian & pasture vegetation, and wildlife habitat over the course of three years. Year one will evaluate with no LTPB complexes present; year two will have between four and six complexes, each with two to fifteen individual structures, plus control sites without structures. The results of the study will be a good baseline of data for NRCS to determine how best to implement LTPB complexes as a tool for EQIP-eligible producers in the Great Plains. An LTPB Complex Installation Workshop and Field Day with NRCS District Conservationists will be held early in the study to familiarize them with the LTPB concept, and another workshop with EQIP producers and NRCS will be held at the end of the study to present the findings and tour a site.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Novel Investment in Grazing Infrastructure

Authors: *Margaret Chamas (Practical Farmers of Iowa); Lara Schenck (Practical Farmers of Iowa)**

Practical Farmers of Iowa demonstrated an innovative use of IA-NRCS funds to provide 18 graziers with cost-share for flexible, portable grazing infrastructure. Farmers invested in portable fencing (such as electronet, poly-wire, reels, step-in posts, and solar chargers) and/or portable watering equipment (tanks on trailers or skids, floats and valves, hoses and fittings, etc.). This equipment allows farmers to implement regenerative grazing principles, which improve pasture management and soil and water conservation.

Participating farmers were sent a follow-up survey where they reported changes in acres grazed, days grazed, number of animals grazed, frequency of pasture changes, hay/stored feed savings, and other information. Because some farmers are grazing cover crops, not all farmers have responded as of the submission date. Responses so far indicate more acres grazed, better management (less overgrazing, more rest periods) of existing pasture, ability to graze cover crops or crop residues, use of marginal/timber areas, and reduced labor. This data will be aggregated and summarized to showcase improvements in pasture management, forage utilization, profitability, or other measures as appropriate.

Results will be reported through info sheets, case studies, and farmers have agreed to host field days to showcase the benefits of the grazing infrastructure cost-share. Return-on-investment will be determined and shared with NRCS staff.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Promoting Adoption of Precision Nitrogen Management Technologies through On-Farm Research

Authors: *Seth Norquest (University of Nebraska)*; Laura Thompson (University of Nebraska); Laila Puntel (University of Nebraska); Taro Mieno (University of Nebraska Lincoln); Javed Iqbal (University of Nebraska); Joe Luck (University of Nebraska)*

Nebraska On-Farm Research consists of a network of professionals that assist farmers in evaluating products and practices that will potentially have a positive impact on the productivity, profitability, and sustainability of their operations. The precision nitrogen (N) management project (PNP) was developed to allow farmers to get hands-on experience with new technologies that may improve nitrogen use efficiency (NUE) and provide data and support to help them decide how these technologies may fit in their operation. Many farmers already have technology that enables them to easily conduct on-farm research such as GPS, yield monitors, and variable-rate application (VRA) equipment. One technology sector in Nebraska that could have improved adoption is the use of precision nitrogen management technologies. Nitrogen management can be challenging due to its high mobility in the soil. Nitrogen leaching into the groundwater impacts water quality and can have negative economic and social ramifications. Nitrogen management technologies aim to increase the efficiency of N fertilizer and therefore reduce N losses to the environment. The technologies are tested for corn and wheat and include crop-model based applications, sensor-based applications, nitrogen inhibitors, and biological fixation products. We've given farmers a hands-on experience with these technologies. There are 40 trials established in each of the three experimental years. Innovative experimental design, in-season data collection for validation, and an automated data processing tool are used to evaluate each trial to give farmers actionable results. In the first year of this study, 98% of the experiments were successfully established. Ninety percent of the successfully established studies were analyzed using the automatic data processing method. The impact of these studies was measured by documenting incremental changes in N management and technology adoption.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Stewardship Ambassadors: Women Landowners Educating Farmers and Other Landowners to Motivate Conservation Change

Authors: *Stephanie Enloe (Women, Food and Agriculture Network (WFAN)); Juliann Salinas (Women, Food and Agriculture Network (WFAN))**

Halfway through the project grant period, this poster presentation will explore preliminary outcomes, successes, and challenges in the program. In addition to poster authors, presenters will include active Stewardship Ambassadors.

Farmland owners (FOs) rent or lease nearly 40% of the farmland in the U.S. (Petzelka et al., March/April, 2021), yet their influence in conservation practice implementation has been largely untapped. This disconnection is particularly evident among women farmland owners (WFOs). While representing nearly 50% of FOs in the Midwest, WFOs have repeatedly identified barriers to engagement and implementation of sustainable agricultural practices, including lack of conservation program information, limited access to conservation resource professionals, and isolation from other WFOs.

Women, Food, and Agriculture Network's (WFAN) Stewardship Ambassador Program (SAP) was designed to identify and address the conservation practice barriers faced by WFOs and expand regenerative agriculture. The SAP innovatively empowers WFOs with the tools and knowledge to be active change agents, including providing: 1) conservation leadership development through needs-specific training, 2) communication strategies, and 3) community-building opportunities. Ultimately the SAP puts women front and center in discussing and educating about land management as trained Stewardship Ambassadors.

With this project, we will expand our SAP by training 48 women in eight states to speak at three agricultural events and with the media. WFAN will train project partners to facilitate WFAN's proven Women Caring for the Land Learning Circle outreach methodology, who will collectively host 16 Learning Circles. As a result, WFAN anticipates at least 60% of the over 2,500 estimated individuals reached by this program will actively engage with their land, ensuring more land is transformed through implementation of diverse agricultural approaches, rooted in conservation values and practices.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Using 3-D Imaging to Estimate Cover Crop Biomass and Characterize Canopy Structure

Authors: *April Dobbs (North Carolina State University)*; Ramon Leon (North Carolina State University); Muthukumar Bagavathiannan (Texas A&M University); Daniel Ginn (Texas A&M University); Søren Kelstrup Skovsen (Aarhus University); Ramawatar Yadav (Iowa State University); Steven Mirsky (USDA-ARS Beltsville Agricultural Research Center); Chris Reberg-Horton (North Carolina State University)*

Variability in biomass production poses challenges for growers when using cover crops for weed control. However, most methods for measuring cover crop biomass are impractical on a field scale. This study evaluated using Structure-from-Motion (SfM) to estimate biomass in cereal rye (*Secale cereale* L.) and winter wheat (*Triticum aestivum* L.). SfM point clouds were generated from videos taken with a hand-held GoPro over crop fields in North Carolina, Iowa, and Maryland, in 2021-2022. Crop height, leaf area index (LAI), and photosynthetically active radiation (PAR) were measured to characterize species-level differences in canopy structure. Biomass was positively related to crop height for both rye (R^2 = 0.621) and wheat (R^2 = 0.55). LAI and crop height were positively related to biomass accumulation in both species, increasing linearly in rye and exponentially in wheat. PAR penetration below the canopy decreased with biomass accumulation and crop height in both species (rye R^2 = 0.769, wheat R^2 = 0.622), with more gradual extinction in rye. Point cloud pixel density was positively related to biomass in rye but saturated after 2,230 lb ac^{-1} (2,500 kg ha^{-1}). In wheat, point cloud pixel density was weakly and negatively related to biomass due to the denser canopy that caused faster saturation of tissue detection. However, crop height integrated with point cloud density had a positive relationship with biomass through levels of 7,100 lb ac^{-1} (8000 kg ha^{-1}). When the models were tested with independent data, predicted and measured biomass were positively related (rye R^2 = 0.859, wheat R^2 = 0.781). Based on the results, SfM provided a more accurate estimation of biomass than canopy height alone. The end goal is to use SfM with a tractor-mounted sensor to map cover crop biomass at termination. This would inform the grower of areas where the cover crop was underperforming, which would allow for targeted treatment of late-season weeds and reduce the overall use of herbicides.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Western Lake Erie Basin—Manure Nutrient Recovery

Authors: *Courtney Taylor (Maumee Watershed Alliance)*; Greg Lake (Maumee Watershed Alliance); Rick Johnson (Applied Environmental Science)*

A Conservation Innovation Grant (CIG Grant) was secured from the USDA-NRCS by the Maumee Watershed Alliance to support our project. The project began April 25, 2022, and will run through February 19, 2024.

Our project's objective is to investigate, evaluate, and advance the use of technologies that can economically recover nutrients from swine manure to levels that can support the transportation and distribution of the recovered nutrients to farm fields that can and will utilize the nutrient content of the manure for crop production. Several methods or techniques have been evaluated and tested. Technologies, such as the use of a Kedensha Rotating Disc Seperator (KDS) and/or the USDA patented suite of QuickWash® phosphorus (QW-P) and ammonia (QW-N) technologies were used.

One of the most common methods of manure storage in the Midwest is under-building deep pit storage (""deep pit"" configurations), especially for swine production which is in use at the host farm. The nutrient makeup of manure can also vary based on feed ration, amount of additional water getting into the waste storage system, or the use, or lack thereof, of phytase products.

Under typical swine production situations, the amount of phosphorus in swine manure is the limiting factor as to how much manure is required to produce a typical corn/soybean crop rotation. Recovered nutrient results of 96% for P2O5 and >93% for ammonia have been consistently achieved resulting in both a stackable high phosphorus product and liquid ammonium sulfate. Both of these are beneficial sources of P and N to support crop production.

Track: 2023 General Conference Theme

Subject: CIG Showcase

Converting Runoff to Irrigation: Assessing the Feasibility of Rainwater Harvesting for Horticulture Production Across the Continental United States

Authors: *John McMaine (South Dakota State University); Mustafa Aydogdu (South Dakota State University)**

Rainwater harvesting (RWH) is a water management technology for capturing, storing, and using water for supplemental irrigation. RWH provides an opportunity to reduce potable water use and downstream peak flow and flow volume. While RWH has great potential benefits with high tunnels (unheated greenhouses) for providing supplemental irrigation for horticulture production across different climatic regimes in the United States, there have not been enough studies on the cost-effectiveness or feasibility of using RWH for supplemental irrigation for high tunnel production across the continental US. This study estimated the amount of water available for supplemental irrigation for growing tomatoes, cucumbers, and beets, as well as the reduction in potable water use and peak flow reduction. In the cultivation of these three crops, we considered different tank sizes, ranging from 250 to 3000 gallons, and high tunnel roof sizes of forty feet by sixty feet as surface and stormwater storage areas where rainwater will be collected theoretically. This study utilized 30 years of precipitation and evapotranspiration data (pulled from the Climate Engine App) adjusted using a seasonally dynamic crop coefficient in different selected state cities in the US. According to a study by Iowa state university tank costs were assumed to be $1.00 per 3.78 L of capacity. This study guides the feasibility and cost-effectiveness of RWH across twelve different states in the US. Another aim is to conduct a study to provide local guidance on RWH as an irrigation supplement and to determine whether it is a suitable technology for vegetable farmers who use high tunnels to extend their growing seasons. According to the results obtained, improvements should be made for irrigation, or it will be said that 2000 (gal) tank size is sufficient for effective irrigation.

Track: 2023 General Conference Theme

Subject: Climate-Smart Agriculture

Developing Irrigation Scheduling Strategies for Drainage Water Recycling Systems in Iowa

Authors: *Eric Henning (Iowa State University)*; Matthew Helmers (Iowa State University); Chris Hay (Iowa Soybean Association)*

In the humid US Corn Belt, climate change projections indicate increasing precipitation in the spring and greater drought frequency and extent in the summer. Without new strategies to adapt to these changes, many current agricultural and environmental challenges may be exacerbated. Drainage water recycling (DWR) is an emerging practice that has the potential to improve cropping system resiliency in this region through the capture and use of subsurface drainage water in irrigation reservoirs. Currently, there are a plethora of research needs associated with DWR, including the optimization of irrigation scheduling strategies. In this study, irrigation scheduling assessments and comparisons were made using soil water balance data collected from three Iowa DWR sites. At each site, soil matric potential was continuously monitored during the growing season at 0.3, 0.6, and 0.9 m depths, and soil water retention curves were generated for each soil series. Additionally, evapotranspiration (ET) during the growing season was approximated using both field-based measurements and satellite-based estimations acquired from a publicly available source (openet.org). Lastly, water table monitoring wells were used to measure the depth of the water table and provide the basis for estimating any upward flux contributions to ET. With these data, we compare irrigation scheduling based on sensor measurements of soil water status to variations of the checkbook method that utilize the different sources of ET data and include/exclude an upward flux component. Our research goals include assessing the accuracy and practicality of various irrigation scheduling strategies and building irrigation scheduling guidance for DWR practitioners in Iowa. Future work will expand on these comparisons and utilize cropping system modeling to optimize irrigation trigger points in DWR systems.

Track: 2023 General Conference Theme

Subject: Climate-Smart Agriculture

Impact of Land-use Systems on Soil Aggregates and Associated Organic Carbon Fractions: Analysis of Time-variable Management Systems in New Jersey Piedmont Soils

Authors: *Ewan Oleghe (Rutgers University, Department of Environmental Sciences); Stephanie Murphy (Rutgers University/New Jersey Agricultural Experiment Station)*; Richard Lathrop (Rutgers University, Department of Ecology, Evolution & Natural Resources); Daniel Gimenez (Rutgers University, Department of Environmental Sciences)*

Strategies to increase soil carbon sequestration through land-use changes have been proposed, but regional assessments to determine the feasibility, understand the effectiveness, and estimate the timeline are limited and rare. To examine the long-term effects of changes in land use on the soil aggregates and associated carbon fractions, which are major soil quality indicators, we sampled soil from fields representative of conservation grassland, pastures (grazed), and forest land-use systems in the Piedmont area of New Jersey, USA. In all cases, fields were selected to represent uniform initial conditions (silt loam soils, humid temperate climate) but with different time periods under a given land use. After segregating soil samples into three aggregate size classes (>250 µm, 53–250 µm, and <53 µm), the two main components of soil organic matter - particulate (POM) and mineral-associated (MAOM) organic matter -were measured, as well as detailed soil particle-size analysis, for each land-use/time/aggregate class combination. Results will demonstrate temporal shifts in carbon allocation across aggregate-size classes and land-use types. The effect of carbon allocation on the structure of pore networks inside each aggregate size class will be examined for possible quantification and correlation. These data have implications for carbon sequestration in soil, providing carbon accrual rates needed for decisions related to climate change mitigation. Extrapolation beyond the time assessed can be achieved by using these data to calibrate mechanistic models linking soil structure and organic carbon dynamics.

Track: 2023 General Conference Theme

Subject: Climate-Smart Agriculture

Integrating Manure Management with Sustainable Intensification of No-Till Corn Silage Systems for Improving Soil Health

Authors: *Gabriella Burkett (Southern Illinois University)*; Oladapo Adeyemi (SIUC); Casey Kula (SIUC); Amir Sadeghpour (SIUC)*

Dairy farmers often use single-season corn (*Zea mays* L.) for silage, leaving the soil bare, leading to erosion and environmental issues, such as decreased soil health, water quality, and increased greenhouse gas emissions. They also apply manure to meet the nitrogen (N) requirement of corn which increases carbon (C) inputs but can overapply phosphorus (P) and increase soil test P (STP), which could decrease water quality. To combat these, growers can (1) adjust N-based applications of manure to a P-based (crop-removal) management, and supplement N need with inorganic fertilizer and (2) integrate winter cereal rye (*Secale cereale* L.; WCR) as double crop. Intensified corn for silage with WCR at P-based rate can improve soil health and water quality by decreasing soil erosion and STP. A four-year trial was initiated in Breese, IL in 2019 with a randomized complete block design and four replicates. Treatments were (1) corn silage with liquid UAN fertilizer; (2) P-based manure with no WRC; (3) N-based manure (liberal N credit) with no WCR; (4) N-based manure (conservative N credit) with no WCR; (5) P-based manure with WRC; (6) N-based manure (liberal N credit) with WCR; (7) N-based manure (conservative N credit) with WCR. We measured crop yield, N and P removal, balances, and STP. Phospholipid fatty acids (PLFA), soil aggregate size distribution and stability, soil bulk density, soil β-glucosidase (BG) enzyme, soil organic C and labile C (POXC) over soil profile, and soil organic matter (SOM) fractions were measured. Integrating WCR with P-based manure rates maintained STP over time. Nitrogen-based manure with WCR increased soil C, reflecting higher fungi:bacteria ratio in the soil without compromising crop yields. However, there was an increase in aggregate stability upon addition of WCR, which can indicate better water infiltration and decreased potential for erosion. Future research should focus on N_2O losses for assessing other environmental impacts.

Track: 2023 General Conference Theme

Subject: Climate-Smart Agriculture

Biochar Boosts the Compost Performance of Methane Fermentation Residue Derived from Food Waste

Authors: *Nursanti Nursanti (Tokyo University of Agriculture and Tekhnologi)*; Syouji Watanabe (Graduate School of Agricultural University Ibaraki); Ratih Kemala Dewi (Tokyo University of Agriculture and Technology); Masakazu Komatsuzaki (Ibaraki University)*

Methane fermentation utilizing food waste represents a sustainable approach; however, its application is frequently hindered by inhibitory properties and suboptimal compost performance compared to commercial alternatives. The incorporation of methane-fermented compost is anticipated to mitigate the growth-inhibiting effects of ammonium inhibition. Additionally, integrating biochar into the compost may enhance nutrient retention capabilities for crop production. This study aimed to assess the impact of various compost mixtures on seed germination and komatsuna (*Brassica rapa*) yield. The experiment employed a food waste-derived methane-fermented compost (MF) combined with biochar (BC), clay (CL), weeds (WD), and a control treatment (water only) in a randomized complete design with three replications for germination observation. Moreover, experimental pots were arranged in a randomized complete block design with two factors of treatment, consisting of the compost type (MF, horse manure (HM), and BC) as the main plot and the compost rate (25 g pot^{-1}, 50 g pot^{-1}, and 100 g pot^{-1}), also conducted in triplicate. In the control treatment, seeds exhibited a 100% germination rate and a radicle length of 17.2 cm. The MF compost alone yielded a 42% germination rate and a radicle length of 2.7 cm. The MF and BC combination increased the germination rate to approximately 76.6% with a radicle length of 4.5 cm. The mixture of MF + HM + BC at 50 g pot^{-1} significantly enhanced komatsuna yield by 12.03%. These findings suggest that biochar provides superior buffering performance against ammonium inhibition, a major concern associated with methane fermentation residue compost, thus promoting plant growth.

Track: 2023 General Conference Theme

Subject: Conservation in Organic, Specialty, Small-Scale, or Urban Agriculture

Assessment of Water Quality under Sensor-based Irrigation Scheduling System in South Carolina

Authors: *Udayakumar Sekaran (Oregon State University)*; Jose O Payero (Clemson University); Dana Turner (Clemson University); Anna Hill (Clemson University)*

Our irrigation research and extension team at Clemson University have developed a cost-effective sensor-based irrigation scheduling system, which uses low-cost open-source electronics, cell phone communication, and Internet-Of-Things (IoT) technologies. It automatically collects data from moisture sensors installed on farmers' fields and transmits the data to the Internet in real-time, which can be accessed remotely by the farmer on a computer or cell phone. An Extension project was initiated in 2020 to promote this technology among farmers in the state. The objectives of this project are to (1) Demonstrate the use of new sensor-based irrigation technology on commercial farms in South Carolina, (2) Evaluate the environmental and economic benefits of sensor-based irrigation technology, and (3) Train farmers and other water stakeholders in the state on the use and benefits of sensor-based irrigation technology. In 2020 to 2022, we conducted 18 on-farm demonstration trials in which the irrigation management of two adjacent fields were compared. We trained the farmers to irrigate one of the fields based on the soil moisture monitoring system's data and to apply their normal irrigation practice on the adjacent field. Suction lysimeters were installed in both fields to collect leachate and quantify the environmental impact of the two irrigation management practices. The results showed that irrigating fields based on the sensor data did not lead to the harmful leaching of soil nutrients. Across all the locations, the mean nutrient content values in the leachate samples of sensor fields recorded lower nutrient content (1.44, 0.17, 12.98, 37.16, 65.94, 0.02, and 3.06 ppm of nitrate-nitrogen, phosphorus, potassium, calcium, magnesium, zinc, and sodium, respectively) than the companion fields (1.70, 0.76, 15.93, 50.19, 98.94, 0.04, and 4.34 ppm of nitrate-nitrogen, phosphorus, potassium, calcium, magnesium, zinc, and sodium, respectively).

Track: 2023 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Dust Mitigation through Sustainable and Resilient Cropping Systems

Authors: *Riley E. Babcock (Texas Tech University)*; Katie Lewis (Texas A&M University Agrilife Research and Extension); Joseph Burke (Texas A&M University Agrilife Research and Extension); Christopher Cobos (Texas A&M University Agrilife Research and Extension); Paul Delaune (Texas A&M University Agrilife Research and Extension); Terry Gentry (Texas A&M University Agrilife Research and Extension)*

In the High Plains of Texas, regenerative practices (cover cropping, crop rotations, and reduced tillage) in cropping systems can be used to prevent further depletion of topsoil due to wind erosion. With conventional tillage being the most common practice, dust events occurred 22 times in 2021 and 39 times (to date) in 2022, therefore cultural practices must be changed to mitigate wind erosion that will impact human health and agricultural sustainability. This loss of topsoil can cause a decrease in agricultural productivity and form dust storms that can be detrimental to human health causing a rise in hospitalizations of chronic lung damage, cardiovascular disorders, and diseases contracted by inhalation. Using regenerative farming practices, both the number and size of dust storms may be mitigated to sustain agricultural productivity and improve human health in this semi-arid environment. We seek to provide a full range assessment of dust properties to enhance human health and agricultural productivity. We will focus samplings in the semi-arid High Plains region of Texas, by obtaining bioaerosol and soil samples across 7 counties. These samples will provide a full assessment of: dust aggregate fractions, quantification of sediment deposition flux, soil moisture and health parameters, meteorological data, and canopy coverage.

Track: 2023 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Improving Surface Drainage Descriptions for Estimation of Soil Erosion over Large Areas

Authors: *Dalmo A. N. Vieira (USDA-ARS)*; Ronald Bingner (USDA-ARS); Robert Wells (USDA-ARS); Brandon Sims (Clemson University (formerly))*

Soil erosion by water continues to be a major threat to the environment and to the sustainability of food production systems. Distributed erosion modeling plays a fundamental role in identifying erosion-prone areas, quantifying soil loss, and associating erosion rates to agricultural practices and to landscape characteristics such as soil types and topography.

Currently, the availability of high-resolution terrain, soils, and land use data allows for detailed descriptions of the physical systems for modeling at watershed and regional scales. Gridded elevation data permit the determination of detailed surface flows representations that consider the effects of local topography on the concentration and accumulation of runoff driving soil detachment and transport.

Geoprocessing algorithms have been developed and combined into a software library to provide high-performance tools for the determination of surface flow paths and channel networks over large areas and at high resolutions. The methodology employs the A-Star Search algorithm and multiple flow directions methods to determine flow distribution. By avoiding the use of depression filling procedures commonly used to solve flow connectivity problems, it produces more realistic, well-connected networks that preserve naturally occurring depressions. High computational performance is achieved with an improved flow accumulation algorithm and through parallelization.

The new methods have been used to create highly detailed and well-connected flow descriptions for the estimation of annual average erosion with RUSLE2 (Revised Universal Soil Loss Equation, Version 2) covering the entire state of Iowa at 10-meter resolution, using machine learning to replace time-consuming computations.

The new state-wide erosion maps provide better information to stakeholders involved in erosion and pollutant control in agricultural areas. This work is part of a new suite of modeling techniques being developed at the USDA/ARS.

Track: 2023 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Assessment of Soil Health Practices Impacts on Runoff and Curve Number Hydrology

Authors: *Umar Javed (South Dakota State University)*; John McMaine (South Dakota State University); Maryam Sahraei (South Dakota State University); Philip A. Adalikwu (South Dakota State University); Kristen Blann (The Nature Conservancy)*

The Soil Conservation Service curve number (SCS-CN) is a popular method for determining the volume of direct runoff based on selected rainfall event. We utilized soil moisture data to calculate runoff and curve numbers for 46 total locations in 23 agricultural fields. All fields are located in the Willow Creek watershed and rainfall events occurred during growing season 2022, were considered. Soil of agricultural fields located in study area consist of Nora series (Nora-Crofton complex and Moody-Nora complex). CN estimates were derived for each field from the TR-55 table based on corresponding mapped Land Use and Land Cover class and Hydrologic Soil Groups from Web Soil Survey. Estimated curve numbers (SCS CN method) were based on HSG and crop rotations at study area fields. Tillage practices effect on curve number variation was assessed across different crop rotations and HSGs by comparing estimated CN to measured CN based on soil characteristics (calculated from observed infiltration). Measured curve numbers varied from default values from standard TR-55 table based on hydrologic soil group, hydrologic condition, cropping system, and conventional tillage. Most fields were mapped as having C and D hydrologic soil groups, but "behaved" as A or B hydrologic groups based on measured runoff characteristics. Based on soil moisture sensor data, row crops on Nora series soils under observed tillage practices consistently exhibit lower runoff characteristics than would be estimated based on mapped hydrologic soil group. Data will be collected for an additional two growing seasons for a full analysis of curve number variation from standard values based on agricultural management practice, antecedent moisture, and precipitation characteristics.

Track: 2023 General Conference Theme

Subject: Edge-of-Field Practices and Monitoring

Bioreactor and Saturated Buffer Stacked Practice in Missouri

Authors: *Gurbir Singh (University of Missouri); Kelly Nelson (University of Missouri)*; Morgan Davis (University of Missouri)*

Edge-of-field practices may synergistically reduce nutrient loss. A bioreactor and saturated buffer was installed in series in upstate Missouri in a field with an in-field controlled drainage system. Nutrient monitoring from five cropping seasons (2018-2022) evaluated nutrient loss based on precipitation events. The field was in a corn (2018, 2020, 2022)-soybean (2019, 2021) rotation. Controlled drainage increased corn yields in 2018 and 2019 (11-13%), while soybean yields increased in 2019 and 2021 (6-10%). Water was monitored for total suspended solids, nitrate-N, total P, TKN, and ortho-P at the inlet and outlet of the bioreactor and at the control structure of the saturated buffer. Nutrient loss reductions of the bioreactor and saturated were determined for precipitation events that were categorized as <13 mm, 13-25 mm, 25-51 mm, and >51 mm. Over the five seasons, nitrate load was reduced 78% at the bioreactor outlet and 88% at the saturated buffer outlet when used in a stacked series configuration. The efficacy of edge-of-field practices was affected by the intensity of precipitation events. This should be taken into account when managing conservation-based cropping systems.

Track: 2023 General Conference Theme

Subject: Edge-of-Field Practices and Monitoring

Effect of Cover Crops on Water Quality of Tile Drained Corn-Soybean Watersheds: A Paired Watershed Approach

Authors: *Ranjith Udawatta (University of Missouri)*; Miguel Salceda (The University of Missouri-Columbia)*

Tile drain was implemented on 23 million ha of Midwest agricultural lands to improve crop productivity although tile drain accelerates dissolved nutrient losses to water bodies and impacts water quality. The objective of the study was to quantify cover crop effects on water quality of corn (*Zea mays* L.)- soybean (*Glycine max* (L.) Merr.) watersheds. This unique study utilized the paired watershed approach with two adjacent watersheds to compare the treatment effects on water quality. Watersheds were instrumented with tile drain systems, flow meters, and water samplers. The study consisted of a 27-month calibration and 26-month treatment periods. Twelve and sixteen paired events were used for the calibration and treatment periods. The cover crop treatment reduced tile flow by 25% as compared to the control watershed. Sediment, ortho phosphate, and total phosphorus in tile drain of the cover crop watershed were 26, 9, and 59% lower than the control treatment. Changes in nitrate and total nitrogen losses were not significant during the study. Results of the study showed that cover crops can be used to reduce tile flow, sediment, and phosphorus losses from corn-soybean watersheds. Results also emphasizes the importance of longer calibration and validation periods to understand long-term effects of cover crops on water quality of tile drain watersheds.

Track: 2023 General Conference Theme

Subject: Edge-of-Field Practices and Monitoring

Microbial Communities as a Pathway to Improved Woodchip Bioreactor Design and Performance

Authors: *Taylor Vroman (Iowa State University)*; Michelle Soupir (Iowa State University); Adina Howe (Iowa State University); Lorien Radmer (Iowa State University)*

Nutrient export from crop fertilizer application via subsurface tile drainage results in water quality damage and potential harm to downstream communities on a local and global scale. Woodchip bioreactors are an upcoming edge-of-field technology that holds great promise as a designed method of denitrifying water. Bioreactors allow agricultural water to interact with microbes from the enhanced carbon source and result in nitrate removal. Woodchip bioreactors are novel technology in that these systems treat water with excess nutrient loads at a higher rate than traditional practices in a smaller physical area. Although we know that woodchip bioreactors are an effective conservation tool, we are not sure which microbes are responsible for denitrification. Six up-flow column systems were designed to represent bioreactors in a controllable environment for monitoring microbial communities, greenhouse gas, and nitrate removal rates. Three columns contain a carbon source of woodchips, and three contain corncobs. The columns will be run for nine months at 3 HRTs (2 hr, 8 hr, 16 hr). Microbial interactions will be studied through monthly DNA extraction from the carbon source. Weekly water samples will be analyzed for ORP, DO, pH, NO_3-N, NO_2-N, NH_4^+, and TOC. Greenhouse gas production will be observed through weekly gas collections. This experiment will help identify key components of microbial communities that will allow researchers to optimize bioreactor design for system improvement. We hypothesize that microbial communities will be dynamic through time, that there will be similarities in GHG production, microbial communities, and water characteristics across carbon sources, and the interaction between agricultural water and carbon sources is key to enhanced nitrate removal rates in bioreactors.

Track: 2023 General Conference Theme

Subject: Edge-of-Field Practices and Monitoring

Soil Moisture Sensors and Surge Valves to Increase Irrigation Efficiency

Authors: *Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service)*; Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service); Pearl Webb (University of Arkansas System Division of Agriculture Cooperative Extension Service); Mike Hamilton (University of Arkansas System Division of Agriculture Cooperative Extension Service)*

Farming is under increasing pressure to reduce environmental impacts. Farmers already monitor their nutrient and water inputs for the best agronomic return. The Arkansas Discovery Farms Program (ARDF) implements best management practices (BMP) like cover crops, and irrigation efficiency management, like computerized hole selection (CHS) for poly tubing furrow irrigation while measuring edge-of-field runoff and nutrient loss to quantify efficiency improvements. The ARDF is looking for techniques and technologies to improve what most already consider efficient irrigation systems. Compounding technological advancements like CHS, surge valves (SV), and real-time soil moisture data has shown potential to greatly increase irrigation efficiency. This study implemented SV irrigation, which automatically alternates full well capacity to portions of a field, to provide a surge of irrigation water, followed by a resting period, to allow water more time to soak into the soil profile. SV irrigation was implemented on one half of a CHS irrigated, row crop field, and compared to the other half of the same field's already efficient CHS irrigation. Irrigation volumes were determined with two independent turbine-type flow meters, soil moisture sensors were used to determine irrigation water infiltration into the soil profile at 6, 12, 18, and 30 inch depths, and automated edge-of-field water monitoring equipment was used to determine tailwater losses. SV irrigation increased irrigation efficiency and reduced nutrient loss. Initial data showed, that while 0.8" less irrigation water was applied to the control than the treatment, the SV increased effective irrigation (water that stayed in the field) by 4.25". The SV increased the irrigation efficiency by 20% and initially reduced nutrient and soil loss in tailwater. Farming practices are ever more scrutinized for sustainability, farmers need a diverse arsenal of conservation tools and technology. SVs and moisture sensors are another tool for that arsenal.

Track: 2023 General Conference Theme

Subject: Edge-of-Field Practices and Monitoring

Assessing the Reliability of Community Science Data Collected by Reservoir Observer Student Scientists (ROSS)

Authors: *Marissa Gerritson (University of Missouri – Columbia, University of Wisconsin Madison); Zohreh Mazaheri Kouhanestani (University of Missouri – Columbia); Emily Kinzinger (University of Missouri – Columbia); Rebecca L. North (University of Missouri – Columbia)*

Lake sampling efforts are most commonly focused during summer months because that is when the majority of human aquatic recreational activities take place. However, cyanobacterial harmful algal blooms (cyanoHABs) can be found year-round, and still produce toxins during the colder months. In order to fill this gap in data collection, as well as educate high schoolers about current water quality issues, Reservoir Observer Student Scientists (ROSS) was created. This program has recruited students at Rock Bridge high school in Columbia, Missouri, for the past five years to collect and filter water samples from Bethel Lake. The objective of this study is to evaluate the data collected by community scientists (the high school students) in order to determine its reliability for advancing our knowledge of water quality issues year-round. Side-by-side samples were collected for total phosphorus, total nitrogen, chlorophyll a, total suspended solids, and two cyanotoxins, microcystin and cylindrospermopsin. We applied a Mann-Whitney statistical test to see if the data from samples collected and filtered by student groups over five years was significantly different from those collected and filtered by MU Limnology staff on the same days. We found that the values from student samples were similar to the values from staff-collected samples for each water quality parameter. This supports the idea that we can rely on data collected by community scientists. These findings reinforce the use of community science in future applications, which could create more credible limnological data for scientific use, as well as help to educate our communities about the importance of water quality.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Building Knowledge about Wisconsin's Cover Crops - A Farmer Citizen Science Research Project

Authors: *Daniel H. Smith (University of Wisconsin-Madison)*; Mrill Ingram (Michael Fields Agricultural Institute); Ricardo Costa (The Nature Conservancy); Jamie Patton (University of Wisconsin-Madison); Dan Marzu (University of Wisconsin-Madison)*

Wisconsin farmers are increasingly interested in planting cover crops and altering traditional crop rotations to allow for improved cover crop growth. Nationally, scientific research and farmer experiences support the use of cover crops to provide diverse soil health cropping system benefits, including reduced soil erosion, increased weed and pathogen suppression, and increased water infiltration rates. However, Wisconsin-specific information on incorporating cover crops and other conservation cropping system practices in dairy and cash crop rotations is lacking. Since 2020, a team of university and community researchers have partnered with farmers to collect data on conservation cropping practices around the state. Participating farmers complete an online survey of agronomic and cover crop practices to identify common management strategies across Wisconsin's varied soil and climatic regions. Participating farmers also collaborate with staff to collect cover crop biomass samples from pre-identified fields to determine potential growth and success of various cover crop species and mixes. Data and information collected through the collaborative project is used to identify research and education gaps, identify potential cover crop best management practices by farm type and geographic region, support farmers peer-to-peer learning experiences, and to improve decision support tools like SnapPlus, Wisconsin's nutrient management planning software. From 2020 to 2022, nearly 100 farmers across Wisconsin have participated in the study. The citizen science approach utilized by this project has generated informational, educational, and social benefits, including engaging farmers in on-farm research, as well as successfully identifying locally appropriate cover crop management practices across Wisconsin's diverse cropping systems.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Developing a Metric to Describe Confinement of Prairie Streams

Authors: *Sam Korducki (North Dakota State University Extension, University of Wisconsin – Stevens Point); Miranda Meehan (North Dakota State University Extension, Department of Animal Science, North Dakota State University); Peter O'Brien (National Laboratory for Agriculture and the Environment, US Department of Agriculture Agricultural Research Service); Benjamin Menapace (Natural Resources Management and Policy, North Dakota State University)*

In prairie streams within the Northern Great Plains, stream entrenchment is common due to the geology and soils of the region. This study aims to evaluate a new metric to define stream confinement and floodplain access of streams with constrained valleys. While the current stream classification system accounts for valley type or composition, which influences stream type, there is currently no ratio or metric used to describe valley confinement. The goal is to develop a ratio that will give us a better idea of floodplain connectivity when comparing streams, especially with those in entrenched states. Since a stream has more ability to meander and connect to its floodplain in an unconstrained valley, valley width and bankfull width were used to create a confinement ratio. Having a higher ratio would illustrate that a stream is less confined and has better floodplain access than a lower ratio. The validity of this ratio was tested using hydrogeomorphic data from 29 stream cross sections across five watersheds in southwestern North Dakota at two points in time, 2016 and 2022. Data was collected in accordance with the Rosgen Stream Classification System. All of the streams sampled were alluvial valleys and therefore valley type VIII, in which confinement is common. The data was analyzed using principal component analysis (PCA) and multidimensional scaling (MDS). The PCA indicated that the confinement ratio has a different relationship with stream type than the other parameters currently used to evaluate streams and is significantly influencing stream channel type. The MDS found that the ratio was positively correlated with both channel type and stability.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Ground Truthing the Accuracy of the Web Soil Survey through Comparison to Soil Cores

Authors: *Lena Ouandaogo (South Dakota State University Extension, Agricultural and Biosystems Engineering, South Dakota State University); Ajoy Kumar Saha (South Dakota State University Extension, Agricultural and Biosystems Engineering, South Dakota State University); John McMaine (South Dakota State University Extension, Agricultural and Biosystems Engineering, South Dakota State University)*

The Web Soil Survey (WSS) is widely used by agricultural and natural resource professionals and practitioners. It is important that users can trust the data quality or at least understand how the soil differs from Due to landscape changes over the past 50 years, the web soil survey may not be reflective of soil characteristics. This study aims to compare the soil layer information obtained from the WSS with characteristics of soil samples collected in the same area. A comprehensive analysis of a small-scale, intensive soil sampling regime compared to the WSS showed significant differences between the soil layer information provided by the WSS and the laboratory experimental results. The differences may be due to changes in sampling techniques and laboratory analysis methods or changes to the landscape by farming practices or erosion. Understanding the gaps between WSS and actual soil samples is crucial for informed decision-making in various fields, including agriculture. The findings highlight the importance of integrating soil sampling with the WSS for more accurate soil characterization and informed land use decisions. Improved accuracy in soil layer information can enhance agricultural practices, environmental conservation efforts, and sustainable land management.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

**Denotes primary author*

Observing the Extent of Education and Outreach on the Nutrient Loss Reduction Strategy

Authors: *Samantha Henry (University of Illinois Extension, Agricultural and Biological Engineering, University of Illinois Urbana-Champaign); Rachel Curry (University of Illinois Extension); Nicole Haverback (University of Illinois Extension)*

Nutrient loss stemming from Illinois agricultural operations is detrimental to both local water quality and the expansion of the Hypoxic Zone in the Gulf of Mexico. Nitrogen and phosphorus loads entering the Gulf of Mexico cause excess algal blooms, which deplete oxygen and create harmful conditions for plants and wildlife. The Illinoisan soils stripped of nutrients have a harder time supporting healthy growth and development of crops. Nutrient loss must be decreased by 45% by 2045 according to the Illinois Nutrient Loss Reduction Strategy (NLRS). Conservation practices such as woodchip bioreactors and saturated buffers are recommended by the NLRS to mitigate this. Nutrient Assessment and Reduction Plans (NARPs) are also endorsed, in which phosphorus inputs are closely monitored. These reductions are not possible without Illinois Extension, which places emphasis on education and outreach to support the NLRS through multiple avenues. The general population and farmers alike can benefit from the Illinois Nutrient Loss Reduction Podcast, which covers conservation practices, legislation, and the efforts of supporting organizations. Farm field days provide the opportunity for Extension professionals to educate the local community and give neutral advice surrounding agriculture. Supplemental materials like fact sheets and brochures easily and efficiently convey the main messages of nutrient loss. This study seeks to determine how these educational opportunities increase public awareness and understanding of the NLRS.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Rain to Rivers: Connecting Precipitation Observations to Flooding in South Dakota

Authors: *Colin Gholson (South Dakota State University Extension, South Dakota School of Mines and Technology); Laura Edwards (South Dakota State University Extension)*

Agriculture is a crucial industry in the state of South Dakota. One aspect that affects agricultural production is weather and climate. Flooding, which is a high-impact event, affects agriculture in numerous ways. Anecdotal reports from agricultural producers and preliminary data suggest that some watersheds with typical spring snowmelt flooding are now experiencing prolonged flooding periods into the summer growing season. The hypothesis for this project is that in recent years, increased seasonal precipitation and/or extreme rain events have increased and that rivers stay above flood-stage for prolonged periods, specifically in the summer season, due to these climatic trends. To conduct this study, data will be utilized from the Community Collaborative Rain Hail and Snow Network, the National Weather Service, and the United States Geological Survey. These data sources will be used to consider river runoff and river gauge levels in conjunction with precipitation data in select agriculture-dominated watersheds in South Dakota.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Shell Creek Watershed Monitoring Project – High School Student Volunteer Monitoring

Authors: *Mark Seier (Newman Grove Public Schools); Katie Pekarek (University of Nebraska)**

Shell Creek runs 110 miles through five different counties in Nebraska and drains approximately 300,000 acres. In the early 1990s, local farmers and conservationists came together to work towards addressing chronic flooding, erosion, and water quality impairments. To better understand these issues, students from Newman Grove, Lakeview, and Schuyler Public Schools have volunteered their summers monitoring water quality since 2002. This poster will explore the efforts of students involved in the Shell Creek Watershed Monitoring Project, the impact of students on public awareness of local water quality, and the influence of technology on the program.

The Shell Creek Watershed Monitoring Project is a combination of hands-on learning and good old-fashioned playing in the mud, which keeps students engaged and wanting to learn more. Teachers have realized that the project is the perfect way to expose high school students to important issues in their community. The Project has evolved into a summertime volunteer program in which high school students spend two days each month, May through August, testing water for physical and chemical factors that contribute to erosion and water quality degradation. Consistent, annual monitoring allows water conservationists and local farmers to take appropriate actions that help to protect the stream. Recently, new technologies have been added to the project, such as drones and GIS. For the past 21 years, the students have compiled all their data and related information onto an extensive website. At the end of each summer, students also summarize their data and present it to the local Natural Resources District and concerned citizens. These efforts have increased public awareness, facilitating the adoption of conservation practices, and leading to the delisting of Shell Creek's atrazine water quality impairment.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

The Effectiveness of Different Materials in Livestock Disposal Piles to Minimize Leachate

Authors: *Josh Mansfield (University of Nebraska Extension, Environmental Engineering, Kansas State University, Biological Systems Engineering, University of Nebraska-Lincoln); Mara Zelt (University of Nebraska Extension, Biological Systems Engineering, University of Nebraska-Lincoln); Gustavo Castro Garcia (University of Nebraska Extension, Biological Systems Engineering, University of Nebraska-Lincoln); Amy Schmidt (University of Nebraska Extension, Biological Systems Engineering, University of Nebraska-Lincoln)*

The improper disposal of livestock mortalities from infectious disease outbreaks can result in the spread of pathogens and harmful pollutants into ground and surface water, risking the health of the community and the further spread of disease to other livestock animals. Traditionally, livestock producers have buried or composted carcasses to dispose of mortalities, often incorporating woodchips for their relatively low cost to accelerate decomposition and prevent the spread of the leachate. However, work currently underway at the University of Nebraska to evaluate the effectiveness of mortality disposal systems for preventing the spread of foreign animal disease outbreaks has demonstrated woodchip-based systems can still produce high volumes of leachate. Thus, there is a need to identify best practice recommendations for livestock disposal that will effectively reduce contamination potential in the event of a catastrophic death event. This research will compare the absorbance potential for readily available carbon wastes (woodchips, cornstalks, recycled paper) alone or in combination with super absorbent or filtering materials (biochar, cellulose fibers, and non-toxic superabsorbent powder or hydrogel) to identify the most effective combinations of materials for preventing potential environmental contamination. Absorbance will be tested by weighing the gain in water weight for each material combination to determine both the water holding potential of the material and how quickly it could absorb leaching materials. This test will be conducted in water alone, as well as in solutions with varied pH (3 to 10) and ion concentrations (1 to 10-3 M NaCl) to observe the resilience of the base material in conditions occurring in a mortality disposal pile. The results of this work will provide insight into the water holding capacity of materials for a large-scale mortality disposal event. Future efforts will use the results of this study in mortality management systems and assess both the quantity of leachate but also the effect of these material combinations on concentrations of chemical and biological pollutants in leachate from disposal piles.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Virtual Great Lakes Water Literacy StoryMap

Authors: *Ethan Davis (University of Wisconsin Extension, College of Natural Resources, University of Wisconsin – Stevens Point, School of Education, University of Wisconsin Milwaukee); Justin Hougham (University of Wisconsin Extension, School of Education, University of Wisconsin Milwaukee, Nelson Institute for Environmental Studies)*

The Great Lakes Quests were developed, in conjunction with Wisconsin Sea Grant, to enhance the Wisconsin Coastal Guide, a website of virtual, interactive maps featuring the many coastal assets in Wisconsin. The Great Lakes Quests are virtual, guided-tours of coastal cities in Wisconsin that highlight locations (natural areas, lighthouses, etc.) and coastal features (maritime history, ecological concepts) that are relevant to that area. We collaborate with environmental organizations in Milwaukee to build the Milwaukee Great Lakes Literacy Quests. The Milwaukee Quest features environmental field trip locations, allowing students to connect with local environmental organizations and become familiar with coastal issues that affect their communities while also connecting educators to local resources. These field trips will expose students to conservation careers and provide them an opportunity to communicate with field professionals, increasing their interest and confidence in communicating science. Through these experiences, students and teachers will develop a community call to action to accompany stops on the Quest.

We have led webinars that describe the Quests, how to use them, and how to create them. For the Great Lakes Quest training in this project, we include integrating Quests into classroom goals and curriculum in the workshop. This training will equip educators with the ability to meaningfully integrate Quests into their curriculum. Educators will learn the types of data that can be collected in our watershed and how to navigate the Quests in ArcGIS StoryMap. Educators will leave the training with the knowledge and skills to use the Milwaukee Quest in the classroom and also create and integrate additional Quests as they support classroom goals. This project has reached over 100 middle and high school students in Milwaukee. Targeting students in this age range provides an opportunity for intervention and enlightenment as students begin to think about career pathway

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Water in Your Jeans: A Water Footprint Comparison

Authors: *Lauren E. Selph (Texas Tech University)*; Tessa Bennett (Texas A&M Agrilife Research)*

Organic cotton blue jeans are often marketed as a more sustainable alternative to conventional cotton blue jeans. The southern high plains region of Texas produces 90% of U.S. organic cotton and 33% of U.S. conventional cotton, but no existing water footprint analyses relate water use to produce the cotton for one pair of blue jeans to climate conditions in this region. A comparative water footprint analysis was conducted using public records and marketing cooperative data to estimate and track water inputs from cotton crop planting through distribution to retailers in each production system. Water inputs to produce 1.5 pounds of cotton (the average amount required for one pair of blue jeans) were estimated to be 4,996.3 gallons in an organic production system and 4,089.7 gallons in a conventional production system in the Southern High Plains region of Texas. Water use in the organic system was, therefore 22% higher than in the conventional system. The difference was largely attributed to lower cotton yields in the organic production system.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

A Novel Remediation Technology for Oil-Contaminated Soils with Ultra-Fine Bubbles

Authors: *Shen-Yi Chen (National Kaohsiung University of Science and Technology)*; Mengshan Lee (National Kaohsiung University of Science and Technology); Tsung-Lin Tsai (National Kaohsiung University of Science and Technology); Wei-Yi Tu (National Kaohsiung University of Science and Technology)*

The soil pollution from oil spillage is a serious environmental problem, not only in the highly industrialized countries all over the world but also in Taiwan. A novel, green and environmentally-friendly technology is urgently required for the remediation of oil-contaminated soils in future. Due to the generation of shock wave and ·OH radical at the moment of bursting of ultra-fine bubbles in water, the bubble bursting energy can be subsequently applied to remove the oil pollutants from contaminated soils. Therefore, the purposes of this study are to develop an innovative soil washing technology for oil-contaminated soils with ultra-fine bubbles, and to investigate the applicability and efficiency of this soil washing technology for contaminated soil remediation by ultra-fine bubbles.

It was found that high percentage (> 90%) and high concentration of ultra-fine bubbles generated in this study belonged to the nanobubbles with mean diameter of 58 nm. These ultra-fine bubbles also had longer retention time in water than microbubbles generated from traditional devices, which will be beneficial to the remediation of oil-contaminated soils. The removal efficiency of TPH from contaminated soils was not enhanced by adding low concentration (20 mg/L) of chemicals (saponin and polyaluminium chloride) in the soil washing process with ultra-fine bubbles. Free hydroxyl radicals generation from collapsing ultra-fine bubbles was found to be the one of main mechanisms for TPH removal from the soils in the soil washing process with ultra-fine bubbles. Also, the removal efficiency of TPH increased with decreasing soil solids content and increasing TPH concentration in soil. The results of response surface methodology indicated that the maximum efficiency of TPH removal was achieved at 200 g/L of soil solids content with 32,250 mg/kg of TPH concentration in soil, where up to 82% of TPH were removed from the contaminated soil.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Assessment of Soil Protein as A Soil Health Indicator and Influence of Management Practices

Authors: *Ekundayo Adeleke (USDA); Skye Wills (USDA-NRCS); Tiffany Carter (USDA-NRCS); Ekundayo Adeleke (USDA-NRCS-NSSC)**

Soil health is receiving increased attention among agricultural stakeholders and government agencies. There is therefore a need to assess soil health using biomarkers that are responsive to management changes. The labile, organic nitrogen (N) pool is a potential candidate for this soil health assessment as it has been known to respond to changes in management and seasonal N availability. The rate of amino acid supply (referred to as depolymerization) is a rate-limiting step in soil N cycling and serves as a pool of N that is bioavailable for mineralization. The Soil and Plant Science Division of NRCS and university cooperators measured bioavailable N using autoclaved-citrate extractable (ACE) soil proteins method across eight states (Oregon, Washington, Kansas, Minnesota, Illinois, Connecticut, North Carolina, and Texas) within five soil survey regions (Northwest, North Central, Northeast, Southeast, and South Central). The soil protein results from different soil series were stratified with management system or ecological state. The management system categories used were business as usual (BAU), the reference condition (Ref) and the soil health management (SHM). The objective of this work was to evaluate ACE protein as a potential soil health biomarker and improve our understanding of the benefits of dynamic soil properties for soil health.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Can We Regenerate Our Land and Water Systems Using the Perennial Groundcover(PGC) System? An Overview

Authors: *Oluwatuyi S. Olowoyeye (Iowa State University)*; Gabrielle M. Myers (Iowa State University); Prathyusha Cheguri (Iowa State University); Memis Bilgici (Iowa State University); Philip Rockson (Iowa State University); Amina Moro (Iowa State University)*

The shift from prairies to the current intensive Midwestern agricultural landscape made the region one of the leading producers of corn and soybeans, but this also resulted in the decline of ecosystem services. Annual row crop production leaves fields bare for extended periods. Because these fields lack living root systems, they are especially vulnerable to soil erosion and nutrient loss and, by extension, lead to broader negative environmental impacts. The washing away of agrochemicals into water bodies threatens aquatic life and causes negative health and economic consequences for downstream communities. Annual cover cropping techniques have been proposed across the Midwest to tackle these challenges and have proven effective in reducing soil erosion and nutrient export. Still, they come with associated challenges, such as logistical conflicts and high costs of replanting each year, leading to low adoption rates. The perennial groundcover (PGC) approach proposes eliminating the barren land aspect by providing continuous soil cover through planting perennial species in conjunction with the annual cash crop. The PGC system would have a lower long-term cost and a reduced management burden compared to annual cover cropping while keeping the soil underneath vegetation all year round. Aiming to develop a well-adapted PGC system to regenerate and recover ecosystem services, the RegenPGC project teams up cross-disciplinary researchers focusing on five different objectives: Crop Ecology and Management, Plant breeding and Genetics, Soil health and Nutrient management, Ecosystem services and Modeling, and Socioeconomic impacts and policy. Successful research in each objective is imperative for the widespread deployment of the PGC system. This poster will overview current research and future directions in each objective.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Carbon Dynamics in Three Land Management Systems in the Northern Great Plains

Authors: *Maria Batool (North Dakota State University); Larry J Cihacek (North Dakota State University)*; Rashad Alghamdi (North Dakota State University)*

Soil is considered the largest terrestrial carbon reservoir in the global carbon cycle, but there are still gaps in our knowledge of identifying changes in carbon stocks in the multi-use land systems. A study was conducted in north central South Dakota to determine differences in the soil organic and inorganic stocks in different land management systems. Transects were sampled across adjacent native grassland (NG), cropped field (CF), and 20-year old Conservation Reserve Program (CRP) sites on similar soil types. A total of 576 samples were collected from each land management with three cores (replicates) sampled to a depth of 1 meter at a five to ten-meter spacing within each transect. Soil organic carbon (SOC) and soil inorganic carbon (SIC) were measured using a carbon analyzer. We found that SIC comprised 5 to 7 times more of the stored subsurface soil C than SOC. When comparing NG, CF, and CRP management systems, the SIC levels in the NG peaked near the 50 cm depth while SIC in the CF peaked near the 75 cm depth. Very low soil moisture levels in the CRP limited the ability to sample below the 50 cm depth in several of the sampling points along the CRP transect. However, the CRP SIC appeared to peak between the 50 and 75 cm depth. The differences in peak depths of SIC accumulation illustrate the differences in soil-water relationships between the three management systems. The three transects were on similar landscape slopes surrounding a common wetland marsh so that position relative to the wetland should not play a major role in the carbon fluctuation at differing depths. We will discuss the implications that the role of SIC has in evaluating the C sequestration in lower rainfall areas of the northern Great Plains.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Cotton-White Clover Cover Crop Production System Utilization for Macro- and Micro-Nutrient Pools

Authors: *Chandler Gruener (University of Georgia)*; Matt Levi (University of Georgia); Nicholas Basinger (University of Georgia); Matthew Thibodeaux (University of Georgia)*

In addition to improving soil quality and increasing organic matter, cover crops can positively benefit nutrient management. Among other things, cover crops can prevent nutrient losses by taking up excess amounts and returning them in organic forms for mineralization and later utilization by cash crops. Another important benefit is reduced erosion by simply keeping the soil covered. In cotton systems, annual cover crops like cereal rye (*Secale cereale*) and crimson clover (*Trifolium incarnatum*) are most commonly used, but recent work has suggested a perennial white clover cover crop (i.e., a 'living mulch') may improve soil health and nutrient management more sustainably. Thus far, work on nutrient cycling in the living mulch system in corn and cotton systems has primarily focused on nitrogen, but the lack of focus on other macro- and micro-nutrients leaves a significant knowledge gap in nutrient cycling. This project focused on the cycling of a more comprehensive suite of macro- and micro-nutrients (potassium, phosphorus, calcium, magnesium, zinc, and manganese) in treatments with different amounts white clover living mulch between cotton rows. Soil (0-10 cm), plant tissue (living mulch and cotton leaves), and free ground-water samples (obtained below the root zone with a suction lysimeter) were collected at key growth stages during the cotton growing season and the non-growing season. The week after the first flower, potassium in cotton leaves and surface soil increased. Higher soil potassium levels resulted in higher white clover potassium levels from luxury consumption. Quantitative accounting of nutrient cycling is in progress and will be presented. These results will shed light on the cycling of important soil nutrients under the living mulch system and quantify the potential benefits from both soil health and economic perspectives. This research is important for meeting agriculture sustainability demands and reducing nutrients' negative environmental impacts.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Exploring Soil Health on Dairy Forage Production Fields

Authors: *Mara Cloutier (Soil Health Institute)**

Management of dairy forage production fields through tillage, cover cropping, diverse cropping rotations, and how/when manure is applied to soils likely influences soil health and soil carbon stocks. The objective of our study was to benchmark the state of soil health and soil carbon stocks in major dairy-producing regions of the United States. This inventory across farms will inform stakeholder groups of the state of soil health and carbon stocks on dairies and opportunities for improvement. Results from dairy farms in Idaho, New York, and Wisconsin will be presented. We anticipate that the grazed dairies in NY and WI will have greater soil health and carbon stocks compared to the row cropped systems and that the use of a perennial in forage rotations in ID will increase soil health and carbon stocks.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

How Do Cover Crops Affect Soil Biological Properties in a Long-Term, No-Till Rotation in Northeast Kansas?

Authors: *Jessica Grunberg (Kansas State University)*; Kraig Roozeboom (Kansas State University); Peter Tomlinson (Kansas State University)*

A healthy soil should deliver multiple ecosystem services and maintain active biological processes, such as carbon cycling and nutrient mineralization. Cover crops (CC) present the potential to improve soil biological properties, although the response of these indicators to long-term no-till management and different intensification schemes still need clarification. A study was conducted since 2008 in a silty clay loam near Manhattan, Kansas, in a no-till wheat – corn – soybean, 3-year rotation. The fallow treatments imposed between wheat and corn included chemical fallow, double crop soybean, crimson clover, rye grass, crimson clover-rye grass mix, and a complex mix of several species. Soil samples were collected in May 2022 in all crop phases, to capture different time intervals after CC termination: immediately after CC termination, in corn stubble one year after CC termination, and in wheat two years after CCs termination. Samples were collected at the 0-5cm depth, and air dried prior to analysis for the following biological indicators: permanganate oxidizable carbon (labile fraction of soil organic carbon), β-glucosidase and β-glucosaminidase (C and N cycling enzymes), soil respiration (indicating microbial activity), and Autoclaved-Citrate Extractable Protein (indicator of bioavailable N). This information can be useful for farmers interested in improving ecosystem services through intensification of no-till cropping systems, particularly enhancing soil biological proprieties. A high response to these soil indicators in CC treatments would confirm CCs capacity for improving soil health.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Planting Green: Potential Benefits and Disadvantages of Planting into a Live Cover Crop

Authors: *Alexis L. Correira (Kansas State University)*; Vincent Otchere (Kansas State University); Peter Tomlinson (Kansas State University); DeAnn Presley (Kansas State University)*

There are several sustainability goals that may be achieved by planting cover crops. Cover crops are used to promote soil health by keeping live roots in the soil and providing a physical mat of protection against geophysical forces that contribute to erosion. Although cover crops are typically terminated 2-4 weeks prior to cash crop planting, there may be situations where late-burndown or planting into a living cover crop (planting green) may be necessary or even beneficial. This experiment investigated the effect of cover crop termination date on cash crop yield and the presence of beneficial insects. Three different termination dates were tested: 4 weeks prior to planting (brown), 3 days prior to planting (green-brown), and at planting (green), as well as a check treatment with no cover crop planted. Preliminary results of sentinel prey assessments indicate no significant difference in the presence of beneficial insects in the systems. However, there was a significant yield decrease in treatments where corn was planted green. The site year by termination data interaction was not significant. Cover crop yields in 2022 were 50% lower than those observed in 2021. The control and planting brown treatments resulted in significantly higher yields than the planting green-brown and green treatments. The planting green-brown and green treatments resulted in a 22 and 60 bu/acre yield penalty respectively. There is one more year of this study in the field, and the results from this experiment will inform decision processes around cover crop termination and assess the potential risks of delaying termination.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Salinity Effects on the Threshold Wind Velocity Necessary to Initiate Erosion

Authors: *Robert S. Van Pelt (USDA-ARS)*; Sujith Ravi (Temple University); Paolo D'Odorico (University of California at Berkeley)*

Throughout man's history irrigated agriculture has been plagued with the accumulation of salts from irrigation water sources. Even with advances in our understanding of how to manage the salts, some accumulation is inevitable as increasing competition for water resources and droughts limit the water available to flush the salts through the bottom of the root zone. In addition, many regions which depend on groundwater for irrigation have aquifers that are underlain by more saline water which may mix with the overlying water as the freshwater is pumped and depleted. We used three cropped soils with textures ranging from loamy sand to clay loam and placed them in soil trays fitted for a laboratory wind tunnel. We wetted the soils through the bottom of the trays to consolidate the microaggregates, dried the trays and salinized the soils with a solution of sodium, calcium, and magnesium salts to achieve salinity levels of 2, 4, and 8 dS m^{-1} in addition to an untreated control. The trays were dried in an oven at 60 C, allowed to cool to room temperature, and equilibrate with an atmosphere of < 40% relative humidity for one hour prior to testing in a wind tunnel. A suction-type wind tunnel was instrumented with a piezo-electric sensor downstream from the soil tray and the wind speed was gradually increased until the sensor registered hits from saltating soil particles. In general, the threshold velocity required to initiate aeolian movement increased with increases in soil salinity.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Seasonal Dynamics and Impact of Phosphorus Fertilizer Treatments and Cover Crops on Soil Health Indicators during Soybean Growing Season

Authors: *Amber Pasket (Kansas State University)*; Nathan Nelson (Kansas State University); Ganga Hettiarachchi (Kansas State University); Peter Tomlinson (Kansas State University)*

Seasonal dynamics of soil health parameters are widely inconsistent in literature due to differences in climate, cover crops, crop rotations, and tillage. A study was established in 2020 to determine the effects of three phosphorus (P) fertilizer management approaches (no-P, build and maintain, and sufficiency), as well as the presence/absence of a cover crop, on different soil health parameters. All treatments were balanced for nitrogen (N) inputs. Composite soil samples were collected (0-5 cm) six times during the 2022 soybean growing season at the Kansas Agricultural Watershed Research Facility (KAW) near Manhattan, KS. Sampling times included a sampling prior to cover crop termination (T0), at cover crop termination (T1), at planting (T2), twice during the growing season (T3-T4) and one sampling post-harvest (T5). Soil health indicators measured included microbial biomass carbon, nitrogen and phosphorus, inorganic nitrogen, total dissolved nitrogen, dissolved organic nitrogen, bioavailable nitrogen, four soil enzyme activities, soil respiration, active carbon, and dissolved organic carbon. Sampling time significantly influenced all measures of soil health. The presence of a cover crop significantly increased all soil enzyme activities and active carbon concentrations. The outcomes of this work will help to inform both the best time to sample and how to interpret soil health assessments from different times in the year. Next steps would be to collect seasonal measurements from a broad range of cropping systems and geographies.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

The Effects of Manure Applications on Soil Greenhouse Gas Emissions in the Texas High Plains

Authors: *Tessa Bennett (Texas A&M Agrilife Reseach)*; Katie Lewis (Texas A&M Agrilife); Joseph Burke (Texas A&M AgriLife Research); Damian Allen (Shell); Jeffery Fedenko (Shell)*

The cost of inorganic fertilizer is continually rising, which has caused an increased interest in alternative solutions. Along with fertilizer prices increasing, carbon emissions are following the same trend. There is an upcoming demand for inorganic fertilizer and carbon research. The purpose of this study was to assess the effects of various manure applications on crop growth and greenhouse gas emissions in three different cropping systems in the Texas High Plains. The no-tillage cropping systems consist of wheat cover/continuous cotton, fallow/cotton/wheat, and fallow/wheat/cotton. Greenhouse gases (CO_2, CH_4, N_2O, NH_3) will be measured on the soil surface throughout the season using a multi-gas FTIR analyzer. Discussion of results will include greenhouse gas emissions for CO_2, CH_4, N_2O, and NH_3.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Toward a National Assessment of Soil Biodiversity: A Framework for Biological Data Collection

Authors: *Tiffany Carter (USDA-NRCS)*; Skye Wills (USDA-NRCS); Dave Hoover (USDA-NRCS); Dave Lindbo (USDA-NRCS)*

Soil microorganisms play a vital role in global nutrient cycling and provide countless ecosystem services. While biodiversity is known to vary with ecosystem and soil type, it has not been captured by most soil and ecosystem hierarchies. Soil survey traditionally collects data related to soil physical and chemical properties. There is growing interest in soil biology and biodiversity as a part of conservation planning for soil health. Thus, there is a need to build NRCS capacity to measure and interpret soil biological data. The USDA-NRCS soil survey has expanded past traditional properties and interpretations to include ecological site information and dynamic soil property data. To meet the increasing demand for soil biological data there is a clear need for the development of efficient and cost-effective methodology that can be used by the National Cooperative Soil Survey (NCSS) to better understand the spatial and depth distribution of biological activity and diversity. This presentation aims to provide a framework for the collection of soil microbiological data across the conterminous US. Various soil types and land management practices uses will initially be targeted. Potential products and insights from this work will be presented.

Track: 2023 General Conference Theme

Subject: Soil Health Resources, Indicators, Assessment, and Management

Nutrient Reduction Capability of Drainage Water Recycling Storage Reservoirs

Authors: *Tyler Meyer (Iowa State University)**

The midwestern corn belt is characterized by heavy cropping and substantial subsurface drainage systems. These drainage systems are a known source of both phosphorus and nitrogen from the region. Many conservation practices have been developed and implemented to help lessen the region's impacts on downstream water. Drainage water recycling (DWR) is a relatively new conservation practice designed to help capture nutrient-rich subsurface drainage and store it for later use in the growing season. DWR consists of an edge-of-field practice capture basin for subsurface drainage and a system to reapply drainage water as supplemental irrigation, such as center pivot or subsurface irrigation. Through capture and storage, these nutrients are held up in the system rather than causing downstream impacts such as algal blooms, most notably in the Gulf of Mexico. This study monitored DWR reservoirs for inflows, outflow, and nutrient concentrations throughout the 2022 growing season and two locations in Central Iowa. Results exhibit a capability for the capture of both phosphorus and nitrogen and a reduction in nitrate-nitrogen and total nitrogen concentrations within the reservoirs throughout the year.

Track: 2023 General Conference Theme

Subject: Water Resource Assessment and Management

Organic Soil Amendments and Their Effect on Soil Health and Water Holding Capacity

Authors: *Ethan LeGrande (Texas A&M Agrilife Systems)**

Soil amendments are a vital part of any farming system, and within the Lubbock area soil amendments that affect water holding capacity can be even more important. Water holding capacity and soil health can be helped with good soil conservation practices such as Cover crops and conservation tillage, but those two practices can add great cost to the grower. The two organic soil amendments we tested have the potential to have a marked increase in water holding capacity, while also increasing the nutrient uptake from the soil, and reducing compaction of the soil. Our project will conduct two laboratory incubations to evaluate the impact of the organic soil amendments (1) water dynamics and (2) microbial performance and nutrient cycling. The experimental units we will use will consist of two organic soil amendments (non-blend vs. blend), six (6) application rates (0, 25, 50, 100, 125, and 150 lb product $acre^{-1}$), two (2) soil types (sand vs. clay), and six (6) replications for a total of 144 units. The first experiment (water dynamics) we will conduct will consist of a 28-d incubation where the experimental units will be weighed daily to determine soil water retention and loss. The second experiment (microbial performance and nutrient cycling) will consist of a 28-d incubation in microcosms that will be evaluated for soil characteristics outlined in the Deliverables section. Statistical analysis will be performed for both experiments using Statistical Application Software (SAS) version 9.3. We are expecting to see a marked increase in the soil's water holding capacity, and a reduction in the amount of water needed to keep plants healthy. We also expect to see an increase in beneficial microbes for increased soil health, leading to a cheaper soil amendment.

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Soil Water Dynamics in Semi-Arid Cotton Conservation Systems

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Water availability and sustainability are essential to the continued agricultural production of the U.S. Great Plains. The Southern High Plains (SHP), located in the semi-arid southern portion of the Great Plains, produces approximately 30% of the U.S. annual cotton production. The continued unsustainable withdrawal of the Ogallala Aquifer for irrigation, paired with the potential increase in annual mean temperature due to climate change puts the future agricultural viability of the region at risk. Our objective was to quantify the amount of water saved using conservation tillage and cover crops in semi-arid cotton production systems compared to conventional continuous cotton systems (CT). The research purpose was to increase producer adoption of conservation systems (no-till continuous cotton with a single species cover crop, R-NT; and no-till continuous cotton with a mixed-species cover crop, M-NT) by reducing irrigation inputs to increase both water and economic sustainability on a regional scale. Total profile soil moisture showed increased soil moisture trends during the early season and through cotton planting for both the continuous cotton with no-tillage and winter rye (*Secale cereal*) cover crop system and the cotton – wheat – fallow rotational system with no-tillage compared to the continuous cotton with conventional tillage system. Results are similar to previous research in water dynamics and sustainability when using cotton conservation systems in semi-arid environments (Burke et al., 2022). However, the cotton – wheat – fallow rotational system with no-tillage had significantly greater cotton lint yields compared to all systems at both high and low irrigation levels for 2022.

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