79TH SWCS INTERNATIONAL ANNUAL CONFERENCE
MYRTLE BEACH, SOUTH CAROLINA | JULY 21-24, 2024

ABSTRACT BOOK

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SYMPOSIA PRESENTATIONS

MONDAY, JULY 22

SYMPOSIA SESSION DESCRIPTIONS AND AGENDA

Conservation Innovation Grants (CIG) Showcase
10:30 AM – 6:30 PM, *Ballroom B 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, July 22. 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 6:30 PM.

Introduction
10:30 AM – 12:00 PM

Session 1: Speaker 1

Title: The NRCS Conservation Innovation Grants Program

Authors: **Caroline Sherony and *Loren Unruh; USDA Natural Resources Conservation Service*

The conservation innovation grants program is a USDA Natural Resource Conservation Service (NRCS) grants program that aims to improve innovation in agricultural operations to improve conservation of US natural resources. The program is available to everyone except federal government agencies, giving opportunity to creative individuals as well as national organizations or university researchers focused on conservation. This talk will highlight the Conservation Innovation Grant program, reviewing the program criteria and eligibility, discuss successful projects and review where to find information on active and completed projects.

Session 1: Speaker 2
CIG Award #: NR203A750008G006

Title: Spectrally-Selective Covering Plastics for Greenhouse Operational Energy Savings

Authors: *Mohammad Elmi*, Enhe Zhang, Julian Wang*; Department of Architectural Engineering, Pennsylvania State University*

Energy management in greenhouses is crucial due to their high energy consumption to maintain optimal growing conditions. This project explores the development and application of spectrally selective solar films to improve greenhouse energy efficiency. The focus is on coating typical greenhouse plastics, such as polyethylene (PE) and polycarbonate (PC) films, with Antimony Tin Oxide (ATO) nanoparticles. These innovative coatings exhibit strong solar infrared-selective absorption with minimal impact on the transmission of photosynthetically active radiation (PAR), providing a new method to manage solar heat without affecting the light needed for crop growth.

The research team proposed seasonal placements of these developed solar films to modulate solar heat gains differently in winter and summer, achieving significant reductions in operational energy use. The greenhouse energy system was modeled for various climate zones, ranging from very hot to subarctic, to examine the effects of ATO coatings on energy consumption. The ATO-coated coverings were compared with single-layer and double-layer PE greenhouse coverings in a detailed energy consumption study.

Results show that using ATO nanoparticles on greenhouse coverings leads to substantial annual energy savings in most climate zones. Although the developed coatings slightly increase lighting and cooling energy consumption, they significantly reduce heating energy consumption, resulting in a 49% decrease in total greenhouse energy use. Based on the study's findings, a guideline for using these coatings in different climate zones was developed to optimize greenhouse energy efficiency. This study opens new avenues for innovative material applications in greenhouses, making them more sustainable and energy-efficient. The advancements in ATO-coated films present a promising solution for reducing greenhouse operational costs and environmental impact.

Session 1: Speaker 3
CIG Award #: NR213A750013G004

Title: Helping Producers Improve Wildlife Habitat with Innovative Seed Coating Technologies and Seed Drill Modifications

Authors: *Matthew D. Madsen*, Brad D. Geary, April Hulet; Brigham Young University*

In the western United States, major conservation efforts are being conducted to improve sagebrush habitat for wildlife. Unfortunately, the application of these conservation programs is being constrained to more productive and often higher-elevation sites. This is because, in the lower elevation, drier sites, direct seeding of native vegetation commonly has high failure rates. We evaluated multiple seed coating technologies and seeding techniques designed to overcome limiting factors impairing seeding success. Separate trials were conducted over a three-year period on degraded rangelands and abandoned agricultural fields dominated by exotic weeds. One of the most promising seed treatments evaluated was a time-release gibberellic acid seed coating, which was found to aid in seed germination and promote seedling emergence from deep planting depths. Fungicide treatments, hydrophobic coatings, and biological inoculants also improved plant establishment at some sites and during certain years. The modification of seeding equipment to create deep, U-shaped furrows and apply amendments over the seed row also dramatically improved seedling emergence and plant establishment, particularly for small-seeded species or on

weedy sites where pre-emergent herbicide was simultaneously applied. Additive effects were further realized when multiple coating and microsite manipulation treatments were employed, resulting in plots having several times more seedlings than those sown with no treatments. The application of these advanced seed coating technologies and innovative seeding techniques has the potential to improve the dismal seeding success rates of native plants. These advancements have the potential to provide a viable path forward for large-scale restoration efforts, which can sustain biodiversity in the sagebrush steppe and other rangeland and agricultural ecosystems.

Session 1: Speaker 4
CIG Award #: NR213A750013G037

Title: Demonstration of management practices and technologies to suppress ammonia emissions from livestock facilities along Colorado's Front Range

Authors: **Auvermann, B. W., and C. B. Brandani (original collaborators, D. B. Parker and K. D. Casey, have now retired); Texas A&M AgriLife Research – Amarillo*

We present the preliminary results from multiple *in vitro* experiments in which we have assessed the potential of solid-set sprinkler systems to reduce – temporarily – the emissions of ammonia from open-lot feedyard surfaces. Early results confirm that sprinkler application of water to simulated feedyard surfaces, as proposed in a CSU thesis by Galles (2011), does in fact reduce NH_3 emission flux for 24 to 48 hours. The effect is modest, and we hasten to observe that the *in vitro* tests do not perfectly replicate open-lot conditions at commercial scale. We therefore present our field protocol for an upcoming (summer 2024) demonstration trial at full, commercial scale at one or two large feedyards on Colorado's eastern plains. We conclude that sprinkler application of water to feedyards has some potential to reduce NH_3 emission flux – targeting the 2- to 3-day duration of most "upslope" events predicted by the Early Warning System – but that the magnitude of the effect will be lower than the relative reductions we will report from *in vitro* experiments.

Session 1: Speaker 5
CIG Award #: NR213A750013G014

Title: Comprehensive demonstration of using agricultural tailwater irrigation for southern crop production

Authors: *Changyoon Jeong*[1], Jim J. Wang[2], Syam K. Dodla[3], and Xi Zhang[1]; [1]Red River Research Station, LUS AgCenter, [2].School of Plant, Environmental, and Soil Sciences, LSU AgCenter, and [3]. IFDC*

A critical limitation to crop production and sustainability in many regions, including Louisiana, is water availability. As a result, alternatives or supplements to a traditional irrigation water source are increasingly being explored. Tailwater recovery systems help supplement traditional irrigation by capturing tailwater and allowing it to be reused for agriculture. Adding constructed ponds as a component of tailwater recovery systems between agricultural lands and watersheds has been proposed as one of the most feasible options to reduce pollutant discharges without adversely altering current production practices. While these ponds are capable of removing a wide variety of

contaminants, including sediment, nutrients, pesticides, and bacterial pollutants, their efficacy as an irrigation water source on crop production has yet to be fully quantified and demonstrated. Tailwater recovery systems could also supplement fertilizers due to the accumulated plant nutrients dissolved within the recovered tailwater. On the other hand, tailwater contains more salts and suspended solids than freshwater irrigation sources, and the interaction between salts and suspended solids could affect soil nutrient cycling and overall physical, chemical, and biological soil health parameters, which have not been well demonstrated. These considerations are important because today's agriculture is increasingly met with a shortage of fresh water. Thus, this demonstration for producers is necessary to understand and predict the potential long-term impact of tailwater irrigation on nutrient cycling and crop production. We found that irrigation significantly improved plant height at harvest by up to 17%, and the biomass at harvest and grain yield by 23 to 30% compared to the control. Among the irrigation treatments, tailwater improved biomass production by 9.1% compared to groundwater. We will demonstrate the simulation of nutrient cycles and crop yields under long-term application of different water sources using the DNDC model.

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

Session 2: Speaker 1
CIG Award #: NR203A750013G010

Title: Demonstrating Cloud-Based Soil Moisture Monitoring for Irrigation Scheduling in South Carolina

Authors: *José Payero[1*], Udayakumar Sekaran[2], Dana Turner[1], Rebecca Hitchcock Davis[1], Jonathan K Croft[1], Nathan B. Smith[1], and Michael W. Marshall[1]; [1]Clemson University, [2]Oregon State University*

The irrigation team at Clemson University developed an affordable sensor-based irrigation scheduling system using low-cost open-source electronics, cell phone communication, and Internet-of-Things (IoT) technologies. The system automatically collects data from moisture sensors installed on farmers' fields and transmits the data to the Internet in real time. The data can be visualized online using a computer or free cell phone app. Farmers can use the site-specific real-time soil moisture information to make more timely and accurate decisions on when and how much irrigation is required. An on-farm trial project funded by the NRCS-CIG program was initiated in 2020. The objectives of the project were to (1) Demonstrate the use of an affordable Internet of Things (IoT) soil moisture monitoring system among commercial farmers in South Carolina, (2) Evaluate the environmental and economic benefits of using the IoT monitoring technology, and (3) Train stakeholders to use the IoT monitoring technology. We conducted eighteen On- Farm-Trials from 2020 to 2022 on local commercial farms. On each farm, two adjacent fields were compared; one was irrigated based on sensors, and the other was based on the farmer's practice. Agronomic and economic data (i.e., crop yield and irrigation applied) were collected to quantify the economic benefits. Our results showed that the IoT soil moisture monitoring system reliably collected and transmitted hourly data from all farms over the three years. The economic analysis results varied by farm and year, but, with a few exceptions, the sensor fields had greater net economic returns than the companion fields. The sensor fields had an average increase in net economic return of

around 10%, representing an average increase of approximately 83 $/acre. These results show the potential impact of expanding Cloud-based soil moisture monitoring technology among commercial farmers.

Session 2: Speaker 2
CIG Award #: NR213A750013G019

Title: Demonstrating Phosphorus Adsorbance in a Slag/Biochar Bioreactor Design for the Treatment of Stormwater Runoff

Author: *Timothy J. Schauwecker*, John J. Ramirez-Avila, Todd Mlsna, Sandra Ortega-Achury, Lorena Chavarro-Chaux, Bailey Bullard, Ansley Hehir; Mississippi State University*

Modern farming has made great advances in increasing the productivity of land and providing food and shelter for the expanding human population. Excess nutrients from animal agriculture systems can potentially be transported to streams and surface waters adjacent to agricultural land and promote detrimental algal blooms which can lead to reduced water quality. Recent advances in bioreactor design for the purpose of removing excess nutrients from agricultural runoff have opened the doors to innovation by using co-product materials such as slag and engineered biochar in novel combinations. Our project's objectives are to 1) determine the total cost and efficacy of the production of large quantities of engineered biochar designed for the removal of dissolved phosphorus from stormwater runoff; 2) Install bioreactors and track all processes and costs; 3) Quantify the impact of bioreactor installation on instream and downstream processes; and 4) Transfer our results to EQIP-eligible producers in the Redbud-Catalpa watershed, the state of Mississippi, and the southeastern US. Our results indicate that the scale-up in production from lab quantities (less than 1 cubic foot) can be accomplished, with 23 cubic yards of engineered biochar produced during our study. Slag and biochar bioreactors were installed in head-cutting gullies in a dairy farm pasture. The bioreactors are made of 4-inch Electric Arc Furnace slag as a grade stabilization structure in head-cutting gullies that were then backfilled with engineered biochar designed to adsorb phosphorus from pasture stormwater runoff. Upstream and downstream water samples were collected from 6 replicates of bioreactor, grade-stabilization-only, and control treatments. We have found that compared to grade-stabilization and control treatments, our bioreactor design reduces the amount of phosphorus reaching the main channel of the stream. Furthermore, it takes a little more than 2 years for the bioreactors to become saturated with phosphorus and lose effectiveness, but in this time the gullies were stabilized.

Session 2: Speaker 3
CIG Award #: NR213A750013G020

Title: N2 Applied: A Novel Approach to Increasing Nitrogen in Animal Manure

Authors: *Mark Stoermann and *Jeff Porter; Newtrient*

When managing livestock, dealing with manure – its treatment, handling, and storage – can be challenging. Nevertheless, spreading manure on land provides valuable nutrients and organic matter to the soil, building soil health and fertility. This practice supplies essential nutrients to

growing crops, enhancing their health and potentially increasing yields. However, there's often an imbalance between the nutrient requirements of planted crops and those provided by animal manures. Traditionally, treatment methods such as waste separation are used to help partition and balance the nutrients applied to growing crops. Alternatively, commercial fertilizers can supplement this imbalance to meet crop nutrient needs. Through a Conservation Innovation Grant, Newtrient has evaluated numerous dairy waste management technologies to help improve the environmental footprint of dairies, with an emphasis on water quality. One such technology, N2 Applied, takes a unique approach to manure and nutrient management. Utilizing plasma technology, N2 Applied extracts atmospheric nitrogen from the air, ionizes it, and then combines it with the manure waste stream. This project evaluated the N2 Applied technology over a 15-week period, assessing the effectiveness of adding nitrogen to manure, the stability of nitrogen in the manure over time, and the ammonia gas emissions, compared to an untreated storage control. The nitrogen content of the waste stream increased by more than 50 percent. By maintaining a pH near 5.0, the nitrogen level remained stable, and ammonia volatilization was minimized. Additional work is underway to improve the efficiency and effectiveness of the N2 Applied system. This presentation will summarize the key findings from the evaluation of this technology.

Session 2: Speaker 4
CIG Award #: NR213A750013G030

Title: Accelerating the adoption of saturated buffers using an educational decision-support tool

Authors: *Ehsan Ghane*[*,1], Yousef AbdalAal[1], Josue Kpodo[1], Amirpouyan Nejadhashemi[1], Mohamed Youssef[2]; [1]Department of Biosystems and Agricultural Engineering, Michigan State University, East Lansing, MI 48824, USA, [2]North Carolina State University*

Saturated buffers (NRCS standard 604) are designed to reduce nitrate loss from subsurface-drained farms. The current design follows a one-size-fits-all approach of choosing a distribution pipe length that diverts at least 5% of the drainage capacity into the saturated buffer. However, local soil, weather, cropping system, drainage design properties differ from one site to another, so we need a site-specific design approach. The objective of this study is to develop and test a new saturated buffer decision-support tool for designing and evaluating saturated buffers based on site-specific conditions. Our goal is to develop an educational decision-support tool for accelerating the adoption of saturated buffers by increasing knowledge of the value of this practice. The CIG Classic-funded tool has two model components: DRAINMOD model and the saturated buffer model. The tool automatically retrieves site-specific data including the local SSURGO soil, DAYMET weather, and digital elevation model as input to the tool. The tool identifies the optimum width of the buffer that maximizes nitrate load removal. The tool also provides the economics of the system to evaluate profitability, including payback period and cost per pound of nitrate removed. During the presentation, we will demonstrate the tool's application for a random farm in Michigan. We also evaluated the tool's performance by comparing its prediction to observed flow and nitrate load from two saturated buffer sites in Iowa. We found satisfactory tool performance of flow and nitrate load based on model evaluation statistics. The value of this tool is that it optimizes the design of saturated buffers for efficient nitrate removal and quantifies its nitrate load removal.

Keywords: DRAINMOD, Saturated buffer, decision-support tool, nitrate, water quality, subsurface drainage

Session 2: Speaker 5
CIG Award #: NR223A750013G030

Title: Western Lake Erie Basin – Manure Nutrient Recovery

Authors: *Rick Johnson[1]*, Greg Lake[2], Courtney Taylor[3]; [1]Applied Environmental Solutions, [2]Maumee Watershed Alliance, [3]Allen County (Indiana) SWCD*

The project's objective was to investigate and advance the use of technologies that can economically recover nutrients, primarily phosphorus (P2O5) from animal waste to levels that can support the transportation and distribution of the now recovered nutrients on farm fields that can be utilized for crop production, or potential resale. The technologies evaluated included the use of low-cost dewatering of raw manure with a Kendensha Rotating Disc Separator (KDS) and the USDA patented QuickWash® suite of technologies, primarily for phosphorus recovery.

Manure nutrient levels vary greatly between the type of livestock being grown & livestock production method. One of the most common methods in the Midwest is under-building deep pit storage, especially for swine production. 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. If the livestock producer limits manure application to the required phosphorus levels for crop production, he most likely will need to supplement his crop nutrient program by applying the required additional nitrogen and potash. Some producers, especially in years past, have elected to apply additional swine manure to levels that now meet crop nitrogen needs, often resulting in an over application of P2O5.

Results from the completed program demonstrated the ability to recover up to 98.5% of available P2O5 through simple dewatering with supplemental polymer addition through use of a high molecular weight, mid-range cationic polymer. Further, slightly higher recovery (99.2%) was achieved with the QuickWash process and conventional dewatering of the raw manure. Economics for both processes will be shown which demonstrates these levels of P2O5 recovery at a cost comparable to conventional land application of manure. Samples of the fully P2O5 recovered swine manure with conventional dewatering were processed into pellets to aid in the transportation and use of the recovered materials. Interestingly though, it was demonstrated that in conventional dewatering of raw manure, 65-75% of the ammonium (NH4) is still available. Using a second technology of the QuickWash suite, this ammonium was recovered in the form of ammonium sulfate, with a demonstrated recovery of 96.9%. Work is continuing to further enhance and demonstrate the ability to maximize the nutrient value of P2O5 and NH4 in the coming year. Additionally, a 2-year field trial of the high-P2O5 recovered pelletized material is also being planned.

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

Session 3 Speaker 1
CIG Award #: NR213A750013G031

Title: Using 3-D characterization and mapping of cover crops and weeds to fight herbicide resistant weeds and avoid reverting back to tillage-based weed control

Authors: *Ramon G. Leon, Avi Goldsmith, and April Dobbs; North Carolina State University*

New imaging and remote sensing technologies provide the opportunity to monitor weed growth and distribution as well as crop performance in real-time. The most common approach has been to use 2D imaging methods for mapping weed populations. However, these systems have major limitations to accurately quantify plant growth. New algorithms have been developed to use 3D imaging to overcome these challenges by using depth data to create accurate plant models. The goal of the present work was to provide a proof-of-concept of how to use 3D images of cover crops to predict their biomass and use this information for weed management decisions. The results showed that structure-from-motion is a technique that can provide accurate estimations of cover crop biomass when both canopy architecture and height are integrated in the prediction model. However, several technical challenges were identified, which must be solved before this technology can be used in farms. Finally, recommendations are provided to increase the efficiency of the system and incorporate the necessary equipment to tractors.

Session 3 Speaker 2
CIG Award #: NR216114XXXXG003

Title: Putting Soil Health to the Test: Can We Reduce N Rates to Corn and Improve ROI?

Authors: *Stefan Gailans[1]*, Gina Nichols[2]; [1]Practical Farmers of Iowa, Ames, Iowa USA; [2]Aarhus University, Aarhus, Denmark*

Many Midwest corn farmers admittedly over-apply nitrogen (N) fertilizer because doing so acts as insurance for a good crop. We argue that this behavior could be curtailed thanks to soil health practices because (1) improved soil health reduces crop response to applied N, and (2) recent scientific evidence also points to less yield variability (e.g. risk) from improved soil health. Soil health practices, thus, represent a potential solution wherein environmental impacts are reduced without compromising farmer economics. In 2022 and 2023, we coordinated 39 on-farm strip trials designed to test the farmer's typical N rate against that rate reduced by an amount of their choosing. Most farms routinely used cover crops in the past five years (29), while some used a diversified crop rotation (8), applied manure (12) or incorporated grazing (10). Farms were predominantly in no-till with some occasionally including strip-till. Farmers chose to test N reductions ranging from 20-60 lb N/ac (reducing 12-50% of their typical rate). Twenty-one of the 39 trials reported no statistically significant reduction in corn yields at the reduced N rates. When considering costs and returns, 23 trials saw a financial benefit from reducing applied N. Reflections from those who experienced financial losses cited trialing less aggressive N rate reductions and

giving their soil health practices more time to improve their soils as main takeaways. Farmers who improved financial outcomes (the majority of whom also maintained corn yields) at the reduced N rate gained confidence from their years of investment in soil health practices for reducing (or at least questioning) their fertilizer rates on the whole farm scale.

Session 3 Speaker 3
CIG Award #: NR203A750013G016

Title: The Future of Farming: Increasing Adoption of Conservation Practices among Alabama Row Crop Farmers

Authors: *[1]Rishi Prasad, *[*1]Brenda Ortiz, *[*1]Audrey Gamble, *[*2]Michele Worosz, *[*3]Leah Duzy; [1]Crop, Soil and Environmental Sciences Department, Auburn University; [2]Department of Agricultural Economics & Rural Sociology, Auburn University, [3]Compliance Services, Lakewood, Washington*

The future of farming truly depends upon conserving and protecting our resources, whether the resource is soil, water, or the environment. Our project builds upon two main philosophies: "Seeing is Believing," and "Learning by Doing." We utilized a systems approach to demonstrate to farmers the benefits of cover crops for improving soil health, smart irrigation technologies to conserve water, and combined practices to improve water- and nutrient- use efficiency. We have formed partnership with three Alabama farmers and established demonstration sites located in north, central and south region of Alabama. Two watershed were identified in each demonstration site and instrumented with edge-of-the-field water quality monitoring systems to demonstrate reduction in nutrient losses from combined cover crop and smart irrigation practices compared to farmer's business-as-usual practices. Another interesting component of the project was establishing a farmer learning sites. We utilized these learning sites to communicate the findings of the project and learn the barriers and limitations to adoption of cover crop systems and smart irrigation practices. Within the project, we also offered cover crop incentive programs to increase adoption of cover crops in row crop farms. The farmers worked directly with Future of Farming team to develop a cover crop plan that addressed resource concerns and cropping systems specific to the participating farmer. Key findings from the project will be presented.

Session 3 Speaker 4
CIG Award #: NR213A750013G006

Title: Bio Inputs and Agroforestry: Strategies for On-Farm Resilience and Diversification"

Authors: *Phal Mantha* and Ricardo Liquet-Gonzalez*; Ridge to Reefs, Inc.*

Currently, agriculture in Puerto Rico is heavily dependent upon imported production inputs. In addition to causing massive crop loss and the widespread destruction of vital infrastructure, events such as Hurricanes Irma and Maria have served to highlight the fragility of food systems and the current paradigm of agricultural production in Puerto Rico. This fragility has been further highlighted by supply chain disruptions associated with the COVID-19 Pandemic.

This project has worked to alleviate critical bottlenecks faced by farmers throughout the Puerto Rican archipelago by reducing dependency on imported production inputs, diversifying agricultural production through the use of agroforestry and syntropic agriculture and using these strategies to improve soil health and agronomic productivity. This project directly contributed to (i) the establishment of 8 regional nurseries across the archipelago to provide valuable plant materials (ii) led to the production and distribution of over 200 cubic meters of high quality biochar amended compost (iii) upcycled local sources of biomass and waste streams leading to the production of over 2000 gallons of Fish Hydrolysate fertilizer, and (iv) worked with 30 farmers across Puerto Rico to establish large areas of cover crops, agroforestry buffers, and successional syntropic agroforestry models.

Updates from DiverseCornBelt: Enhancing Rural Resilience through Landscape Diversity in the Midwest

Room Ballroom C on Main Level

Track: Adaptive Management of Conservation Efforts

Time: 10:30 AM – 12:00 PM

Moderator: *Linda Prokopy, Purdue University*

Author: *Emily M Usher (Purdue University)**

The Diverse Corn Belt project (DCB) is a 5-year USDA –NIFA-funded project that aims to identify pathways to a more diversified agricultural landscape across the Midwestern Corn Belt, focusing on Indiana, Illinois and Iowa. Using an integrated and transdisciplinary approach, the DCB team is engaging with diverse stakeholders across the agricultural supply chain to coproduce a systemic analysis and assessment of viable pathways to a more diverse Corn Belt.

This symposium will provide an overview of the entire DCB project and updates on recent activities, including in-field data collection and results from farmer surveys, focus groups and interviews. We will also share and engage participants in our process of planning and conducting Reimagining Agricultural Diversity (RAD) Team meetings, share preliminary results, and outline next steps. RAD Teams are DCB's long-term state-wide stakeholder engagement group that meet to discuss opportunities and barriers to agricultural diversification as well as provide feedback and insight to project findings. RAD participants include a range of stakeholders (farmers, advisors, landowners, local decision makers and agency staff, etc.), and provide a critical opportunity for researchers to understand perspectives of agricultural stakeholders in the region. The symposium will also include a discussion related to information and resources needed to develop regional plans for agricultural diversification.

Fostering Inclusivity in the Quad Cities: A Two-Year Journey Towards an Inclusive Environmental Movement

Room 106 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 10:30 AM – 12:00 PM

Moderator: *Bre'Anna Brooks, Walton Family Foundation*

Authors: *Clare L Lindahl (Soil and Water Conservation Society)*; Bre'Anna Brooks (Walton Family Foundation)*

Join us for an informational and interactive session that delves into the challenges and triumphs of community-based environmental work along the Mississippi River. Faced with intense weather and flooding, the Quad Cities region faces significant economic and environmental issues, especially as the climate changes.

In November 2021, the Walton Family Foundation launched a project to foster an inclusive environmental movement in the Quad Cities. A community assessment completed at the beginning of the project revealed riverine flooding as a primary concern, particularly affecting communities of color are oftentimes not included in community or environmental decision-making. Despite these challenges, we have witnessed remarkable progress. Notably, the Quad Cities Community Foundation awarded over $360,000 to twelve local organizations through the community-designed QC River Connections Grants program, with 84% of funding going to BIPOC-led projects. This initiative demonstrates a successful commitment to prioritizing underrepresented communities.

This session will showcase the two-year journey, highlighting how local and national stakeholders collaborated to integrate environmental and DEI efforts. Learn about our MEL (Monitoring, Evaluation, and Learning) methods used to measure and adapt our strategies. Best of all, members of the Clean River Advisory Council will be present to share their experiences in shaping the grant program and creating a Mississippi River Equity Vision that centers community priorities.

Discover how we are moving forward, applying lessons learned to ensure sustainability and lasting impact. Be inspired by the stories of resilience and relationships, and think of ways you might contribute to building a more inclusive and environmentally just future.

Concept Design of Edge of Field Practices

Room 107 on Main Level

Track: Conservation on the Edge

Time: 10:30 AM – 12:00 PM

Moderator: *Caleb Rasmussen, ISG*

Author: *Caleb Rasmussen, ISG*

With Edge of Field Practices ramping up, the need to quickly and responsibly identify suitable sites is needed to keep momentum. This session will show critical engineer decision making components for focused on saturated buffers and discussing bioreactors and wetlands as well that would help direct survey, concept development, and inform landowners. The session will look at NRCS practice requirements and how they drive a practice layout, as well as address common issues with design of each practice. Concept layouts of a saturated buffer with multiple tile will be used during the session to guide design process and facilitate audience participation.

Education for Impact: Optimizing Natural Resource Management through the Food-Energy-Water Nexus Framework

Room 108 on Main Level

Track: Outreach, Education, and Community Engagement

Time: 10:30 AM – 12:00 PM

Moderator: *Anil Kumar Chaudhary, The Pennsylvania State University*

Author: *Anil Kumar Chaudhary, The Pennsylvania State University*

Sustainable natural resource management is no easy feat - uncertainties, diverse perspectives, and varying scales add layers of complexity. Worldwide, there is growing interest in education using the Food-Energy-Water (FEW)-Nexus, which serves as a framework for addressing multifaceted natural resource challenges within coupled human-natural systems. Educators see the potential of FEW-Nexus to promote systems thinking and interdisciplinary problem-solving. However, implementing FEW-Nexus in educational settings poses multiple challenges, including limited instructional resources on its effective use. Education research can inform effective strategies for implementing novel approaches like FEW-Nexus education in practice. The goal of this session is to define new priority areas for natural resource management professionals (NRMPs) in support of FEW-Nexus-based education. Facilitated by one of the leaders of the National Collaborative for Research on Food, Energy, and Water Education (NC-FEW; https://serc.carleton.edu/nc-few; NSF-Funded RCN: 2242276), the session will bring together NRMPs who are (or would like to be) engaged in FEW-Nexus-based education. Recent NC-FEW work will be shared as a starting point, adding additional perspectives from workshop participants throughout. The objectives are: 1) define FEW-Nexus-based education, 2) identify and describe challenges with FEW-Nexus-based education, and 3) ideate ways in which natural resource management (NRM) research and practice can generate new knowledge to address these challenges. These objectives will be met through a learner-centered sympoium with interactive activities aimed at generating small-group discussion and collaboration among participants. The session will equip participants with FEW-Nexus insights for tackling NRM challenges, boosting stakeholder engagement, and fostering connections with NC-FEW.

Policy Challenges and Opportunities for Sustainable Water Allocation and Use in Agriculture
Ballroom C on Main Level

Track: Conservation Economics and Policy

Time: 1:30 PM – 3:00 PM

Moderator: *Gretchen Sassenrath, Kansas State University*

Authors: *Deepthi E Kolady (Oklahoma State University); Clark Gantzer (University of Missouri); Lisa Duriancik (USDA NRCS); Gretchen Sassenrath (Kansas State University)**

Water deficit and water excess are two challenges facing farmers and communities in the Upper Midwest of the United States. Excess moisture leads to crop loss at the field scale as well as flooding at the watershed scale. Deficit moisture conditions lead to crop loss or reduced crop productivity as well as potential water shortages for communities. Conservation agriculture and soil health advocates have pointed to improved capture and storage of precipitation as a way to mitigate both extreme conditions. While past research has documented improvements in parameters such as organic matter and water holding capacity, the extent to which these changes affect water volume and peak flow at the watershed scale has been less rigorously studied.

The Roadmap to Water Resilience project, in southeast South Dakota, combined field measurements with social science and economics to model watershed-scale impacts of field-scale conservation implementation. Results from local social science surveys were incorporated into the modeling to develop realistic implementation scenarios. Incentive payments, as part of these scenarios, were then applied to each implementation scenario to understand the potential cost that would be incurred for a downstream entity to support conservation implementation as a way to reduce flooding. Policy implications include expected outcomes from payment for ecosystem services models and improved resilience to weather extremes at the field scale. This approach could be used to understand the impact of likely scenarios of conservation implementation for other ecosystem services.

Around the world, agriculture's impact on groundwater supplies and on groundwater quality, and the dependence of agricultural and rural communities, their urban neighbors, and of surrounding environments on groundwater as a source of drinking and irrigation water have recently come into the spotlight of many regional, national, and global policymakers, water managers, regulators, and consumers. This presentation provides a report-out from a unique inter- and transdisciplinary international conference held in June 2024. It provides an opportunity to link the work in "Toward Sustainable Groundwater in Agriculture - Linking Science and Policy" to the Soil and Water Conservation audience for further engagement. The conference takes a closer look at the groundwater-food nexus to develop shared insights to understanding, managing, planning, and working at the interface between groundwater and agriculture. The conference focuses on solutions that achieve better distribution of a limited resource in an efficient and equitable manner throughout affected regions with shortage, overdraft, and/or compromised groundwater quality. Out of shared understanding, the conference identifies common threats and pitfalls and the most promising solutions. Key drivers include the value of groundwater in agriculture, agriculture's

impact on groundwater quality and quantity, and groundwater's role in food security and in climate resiliency of agricultural/rural communities and agricultural production, thus highlighting the groundwater-agriculture nexus across sectors.

Agriculture is directly impacted by climate change due to shifting weather patterns and increasingly frequent and severe storms, floods, and drought. Conservation activities addressing water quality and quantity can also play a key role in adapting to these climatic changes. The USDA Natural Resources Conservation Service (NRCS) provides technical and financial assistance in support of climate-smart agriculture and forestry (CSAF) delivering climate solutions across the nation's working lands, regardless of the size, location, or type of their operation. This presentation will highlight how implementing conservation activities can enable farmers and ranchers to adapt to climate change while also building long term resilience to drought, floods, and other extreme weather. Topics will include the Western Water and Working Lands Framework for Conservation Action, flood prevention programs, irrigation efficiency projects, and water quality efforts.

Overview and Updates to Wind Erosion Prediction Tools: Session 1

Room 106 on Main Level

Track: Conservation Models, Tools, and Technologies

Time: 1:30 PM – 3:00 PM

Moderator: *Chris Coreil, USDA NRCS*

Authors: *Chris Coreil (USDA-NRCS)*; Larry Wagner (USDA-ARS); Fred Fox (USDA-ARS); Denise Troxell (USDA-NRCS); Kalyn Taylor (USDA-ARS)*

The Wind Erosion Prediction System (WEPS) and Aeolian Erosion (AERO) models were developed by Agricultural Research Service (USDA-ARS) to assess wind erosion and dust emission on working lands. Both models have seen significant updates over the last few years. This two-part symposium focuses on the current state of wind erosion technology. Session 1 provides an overview of the new WEPS WebStart features, current tool developments and direction, a review of the most common input errors and software limitations, as well as an in-depth discussion on windblown residue research and model inputs. Conservation planners, researchers, educators, and consultants interested in wind erosion science and assessment should plan to attend this comprehensive discussion.

So What? The Art of Science Communication

Room 107 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 1:30 PM – 3:00 PM

Moderator: *Laura E. Crowell, USDA NRCS*

Authors: *Laura E Crowell (NRCS)*; Elizabeth Creech-Thomas (NRCS); Julia Debes (WLFW)*

Session 1 — Art Supplies: Seven Proven Steps for Crafting Effective Science Communication

Presenters: Elizabeth Creech-Thomas, Natural Resources Conservation Service, Emma Harper, Soil and Water Conservation Society

Many artists create their work using sets of basic common tools and supplies, like brushes, pencils, paint, and canvas. Effective communicators also use an important set of tools, or a series of basic steps and questions, to craft communication products from collections of data, facts, and images. Presenters will discuss the importance of effective communication, and the essential steps required to create it. Learn more about mastering the art of science communications, and how to better support your organization's communications professionals who work to tell your stories and share your successes.

Session 2 — Art Exhibition: Effective Science Communication Case Studies

Presenters: Elizabeth Creech-Thomas, Natural Resources Conservation Service, Laura Crowell, Natural Resources Conservation Service, Julia Debes, Working Lands for Wildlife, Emma Harper, Soil and Water Conservation Society

Effective science communication can be crafted in many different forms, based on audience, goals and objectives and available resources. While data is objective, the best way to communicate it can be very subjective. In this session, our group of presenters representing NRCS, SWCS and Working Lands for Wildlife, will share case studies from their organizations and highlight how the products were created, share the reasons behind their product decisions and the lessons they learned along the way. Join this session to get some practical ideas on how to create your own science communication products.

Session 3 — Art Workshop: Crafting Your Own Effective Science Communications

Presenters: Julia Debes, Working Lands for Wildlife, Laura Crowell, Natural Resources Conservation Service

In this session, presenters will talk through the cascading strategy behind effective science communication---or how to craft multiple communication successes from a single primary piece. They will explain why your organization's communication staff aren't really trying to pester conservation professionals but are striving to use this strategy to boost efficiency and overall impact. Presenters will lead participants through a series of interactive examples created to

illustrate how to use the seven proven steps of effective science communication to improve even the most basic of communication efforts.

Soil Moisture Monitoring for Megafarm Optimal Irrigation

Room 108 on Main Level

Track: Water Resource Assessment and Management

Time: 1:30 PM – 3:00 PM

Moderator: *Seyed (Reza) Zekavat, Worcester Polytechnic Institute*

Authors: *Seyed (Reza) Zekavat, Worcester Polytechnic Institute*

Current irrigation technology is still developing. Typically, irrigation systems apply the same amount of water across farmlands, regardless of soil type and existing water/moisture content. The challenges posed by climate change, decreasing water table volumes, and droughts motivate optimal irrigation strategies. This session explores various aspects of the state of US water tables and new technologies based on an intelligent radar system designed to measure soil moisture accurately and improve water utilization. Based on 3D moisture data up to the root zone achieved by this technology, we can optimize irrigation according to soil moisture patterns. This non-invasive and rapid technology employs a Ground Penetration Radar (GPR) system mounted on a drone. The radar data will be processed using machine learning (ML) methods. Specifically, drone-mounted GPR allows for quick scanning of large-scale farms. This symposium aims to address many aspects key to water usage and optimal irrigation technologies.

Advancing Research on Nutrient and Sediment Legacy Sources and Strategies for Mitigation

Ballroom C on Main Level

Track: Adaptive Management of Conservation Efforts

Time: 3:30 PM – 5:00 PM

Moderator: *Lindsey Witthaus, USDA ARS*

Authors: *Lindsey Witthaus (United States Department of Agriculture - Agricultural Research Service)*; Lisa Duriancik (USDA NRCS); Joshua Mott (USDA-ARS); Mark Williams (USDA_ARS); Eddy J Langendoen (USDA ARS); Cathleen J Hapeman (USDA-ARS)*

Conservation science has made great advancements in field and edge-of-field nutrient management and erosion reduction strategies. However, legacy sources of nitrogen, phosphorus, and sediment challenge successful restoration of downstream ecosystems. The USDA-NRCS has partnered with USDA-ARS to improve knowledge of legacy contributions within diverse US watersheds and to provide recommendations on conservation strategies to mitigate legacy effects. This symposium will have a brief introduction to the series of projects followed by in-depth research talks. The objectives of this symposium are to 1) provide an overview of the series of projects funded by NRCS to support research on nutrient and sediment legacy sources; 2) present research outcomes and progress on the various projects; 3) discuss areas of overlap amongst the projects to improve synergistic efforts and enhanced project outcomes.

Overcoming the Challenges of Regenerative Ag Systems in Water-Limited Environments

Room 106 on Main Level

Track: Climate-Smart Agriculture

Time: 3:30 PM – 5:00 PM

Moderator: *Nicholas F. Boogades, Texas A&M AgriLife*

Authors: *Nicholas F Boogades (Texas A&M AgriLife)*; Katie Lewis (Texas A&M Agrilife); Paule DeLaune (Texas A&M Agrilife); Joseph Burke (Texas A&M AgriLife Research); Christopher Cobos (Texas A&M AgriLife Research)*

Agricultural production in the U.S. Southern Great Plains (SGP) is expected to become more challenging due to climate change, dwindling aquafers, increasingly dry conditions, and increased demand for goods. Bolstering the resiliency of production systems in the region will be supported by preservation of local soil and water resources. Regenerative agricultural practices can increase the resiliency of production systems, but their impact and feasibility in water-limited areas are poorly understood. Regenerative agriculture can possibly increase long-term sustainability by improving conservation of soil and water resources, but there are several barriers which need to be overcome before widespread implementation is possible. First, adoption of conservation practices is very low in the region. Previous research on conservation practices has shown no yield benefits, causing reluctance among producers to adopt such practices primarily due to concerns over cover crop water use. Second, the environment creates unique barriers to the adoption of intensified regenerative systems because of low potential net primary production (NPP). Limited rainfall and aquifer depletion make it difficult to produce the necessary biomass needed for certain ecosystem service benefits, as seen in wetter regions. These systems can increase soil organic carbon (SOC) readily due to large biomass inputs, which further benefits soil and water conservation and improves system resiliency. Regenerative agriculture in semi-arid regions must overcome low potential NPP and build SOC by closely managing SOC inputs and losses, rather than simply increasing carbon inputs through system intensification. Lastly, crop diversification in the region is low, with 60% of acres devoted to cotton and limited other viable options depending on a producer's location within the SGP. Therefore, the goal of this project is to define regenerative agriculture practices for the SGP and identify management that benefit the long-term viability of agricultural production for the region in an environmentally and economically sustainable manner. This series of presentations will address challenges at the systems level, down to practices as specific as cover crop termination timings to maximize the benefits of regenerative agriculture in the SGP. Specifically, we will discuss producer barriers to adoption and the effects of regenerative practices on soil water, fertility, greenhouse gas emissions (GHG), and yield. Our results indicate that improvements in SOC, stored soil moisture, and yield are possible with the implementation of regenerative practices, with little negative impact on environmental factors such as GHG emissions. Further optimization of these practices is still required for widespread implementation across the SGP, however it does appear that regenerative agriculture can improve the sustainability of agriculture in the region by securing its soil and water resources.

Overview and Updates to Wind Erosion Prediction Tools: Session 2

Room 107 on Main Level

Track: Conservation Models, Tools, and Technologies

Time: 3:30 PM – 5:00 PM

Moderator: *Chris Coreil, USDA NRCS*

Authors: *Chris Coreil (USDA-NRCS)*; Larry Wagner (USDA-ARS); Grace Wilson (University of Minnesota); Nick Webb (USDA-ARS); Jeremy Schallner (New Mexico State University)*

The Wind Erosion Prediction System (WEPS) and Aeolian Erosion (AERO) models were developed by Agricultural Research Service (USDA-ARS) to assess wind erosion and dust emission on working lands. Both models have seen significant updates over the last few years. Session 2 will cover WEPS wind erosion management system risk and updated reports, provide an overview of WEPS Single-event Wind Erosion Evaluation Program (SWEEP) integration into the Daily Erosion Project, an overview of AERO features, AERO use in supporting land health assessments and examples, and future AERO developments and direction. Conservation planners, researchers, educators, and consultants interested in wind erosion science and assessment should plan to attend this comprehensive discussion.

Crop Insurance Incentives for Cover Crops: Scaling Conservation from State to Federal

Room 108 on Main Level

Track: Conservation Economics and Policy

Time: 3:30 PM – 5:00 PM

Moderator: *Lara Bryant, Natural Resources Defense Council*

Authors: *Lara Bryant (Natural Resources Defense Council)*; Kris Reynolds (American Farmland Trust)*

In 2018, the Iowa Department of Agriculture and Land Stewardship (IDALS) launched a first-in-the-nation program that rewarded farmers who plant cover crops with a $5 per acre discount on their crop insurance. Between 2020 and 2022, Illinois, Indiana, and Wisconsin launched similar programs. In 2021, after USDA announced a nationwide incentive modeled on the state programs, farmers enrolled more than 14 million acres for crop insurance savings. Unfortunately, USDA's program was short-lived; despite its popularity, funding for the program expired in 2023, and as of January 2024 has not been renewed. This symposium will discuss this case study as an example for scaling conservation incentives from state-to federal policy, with key updates on new states added and additional analysis from a previous symposium delivered virtually to SWCS in 2021.

First, we will hear a recap of the launch of the state crop insurance programs from policy advocates who worked with state agriculture departments and USDA to launch and promote the programs. On-the ground-experts will discuss the program details and an update on how implementation has evolved since 2021, including the programs' challenges and lessons for success.

Then, we will hear about program evaluation and lessons learned from evaluation surveys conducted in 2022 by Indiana University in partnership with The Nature Conservancy. Our speaker will share the details of how a three-state survey was created and distributed and present a detailed analysis of survey findings. We will discuss the effectiveness of the programs as an incentive for increased cover crop adoption and the conservation and climate impacts of the programs.

Finally, we will analyze USDA data from the two years of the national program, sharing which states enrolled the most cover crops, summarizing efforts to renew funding for this policy at the federal level, and forecast the future for expanding state and national incentives.

TUESDAY, JULY 23

SYMPOSIA SESSION DESCRIPTIONS AND AGENDA

CEAP Showcase
10:30 AM – 5:00 PM, *Ballroom B on Main Level*
The USDA's Conservation Effects Assessment Project (CEAP) is a multiagency effort to develop tools and methods to quantify and interpret the outcomes of Farm Bill programs and NRCS conservation practices. These conservation efforts affect multiple ecosystem services provided by wetlands embedded in or adjacent to agricultural production systems, including nutrient mitigation, carbon and water storage, and provision of wildlife habitat. One goal of CEAP Wetlands is to document outcomes of wetland restoration and easement programs on the multiple ecosystem services provided by wetlands in agricultural landscapes. Presenters will highlight key findings from CEAP–Wetlands studies that assess factors affecting hydrology, sediment and nutrient dynamics, and carbon cycles at various scales, and discuss contributions to an improved understanding of wetlands, the provisioning of ecosystem services, and the effects of restoration and management. Assessments include wetland easements and restorations in the Mississippi floodplain, Lake Champlain basin, and mid-Atlantic and southeast coastal plains. Representatives of agencies that evaluate conservation program outcomes that affect wetlands, and those interested in tools and methods to quantify conservation practice effects on wetland ecosystem services may benefit by attending this symposium.

Conservation Outcomes in CEAP Watersheds
10:30 AM – 12:00 PM

Moderator: *Kevin King, USDA ARS*

Presentation 1: Impacts of Scientific Studies from the CEAP Goodwin Creek Experimental Watershed - *Ron Bingner, Eddy Langendoen, Andy O'Reilly, Dalmo Vieira, Robert Wells, Daniel Wren*

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 km2 watershed was chosen for its mixed landuse, 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. Major impacts from the research studies on GCEW are: 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 landuse shift of cropland to forest and pasture from the 1980's 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%. The research on GCEW has resulted in hundreds of journal articles and reports that have provided decision makers with vital information on the impact of conservation practices on channels and watersheds in highly erosive systems.

Presentation 2: Hydrologic Impact of Agricultural Management and Climate in the Little River Experimental Watershed - *Pisarello, K., Coffin, A., Bosch, D., Pisani, O., and Strickland, T.*

Science has evolved toward a new era of data abundance, where empirical evidence is available more than ever to build and support conclusions about agricultural biophysical systems that are increasingly subject to spatiotemporally varying climate and land management drivers. Research in the USDA Little River Experimental Watershed (LREW) in Tifton, GA has provided more than 50 years of hydrological, climatological, and agricultural data, which has been frequently applied to enhance our collective understanding of agroecological systems across scales. Ongoing LREW research data are integrated with modeling efforts to help improve regional and national characterizations of agriculturally relevant data products. These products have important implications for evaluating physical and biological responses to alternative agricultural management practices as well as climate change impacts. In this study, we used our large multi-disciplinary datasets to evaluate how conservation management practices (i.e., conservation tillage and winter covers) and anticipated changes in rainfall and temperature will impact water quantity and quality in a sub-basin of the LREW across time and space. These relationships were modeled statistically for the purpose of informing and refining process based models, like SWAT, and to advance our comprehensive understanding of the hydroclimatic-agronomic system at both local and regional scales.

Presentation 3: Conservation Effects Assessment Project in Northeast Arkansas- *Michele L. Reba, Niroj Aryal, Geoffrey Payne, Anna Pieri, Tina Gray Teague*

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 2024 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 are deployed at five locations each. A synthesis of

findings from LRD from 2015 to 2023 will be presented, while initial findings from the new watershed will be presented.

Presentation 4: Evaluating the efficiency of water quality ponds at removing sediment and nutrients in irrigation return flow in the Upper Snake-Rock watershed - *Kossi Nouwakpo, Isis Scott, and Dave Bjorneberg*

Hydrologic processes in highly managed agricultural systems share some similarities with rainfed systems but have distinct characteristics that present both opportunities and challenges for modeling and water quality improvement efforts. The Twin Falls Canal Company (TFCC) irrigation project diverts water from the Snake River to provide irrigation water to 82,000 ha of agricultural land in southern Idaho. Sediment and phosphorous (P) load to the Snake River from irrigation return flow has been a major concern in the region. Water quality ponds are one of the most common practices used by the TFCC to improve water quality along major irrigation return flow routes. These ponds can reduce sediment concentrations 20% to 70% depending on inflow sediment loads and pond size, design, and vegetation level. Reducing sediment concentrations also results in lower total P concentrations but water quality ponds generally have little impact on dissolved P concentrations. Detailed water flow and quality monitoring of two ponds with a salt tracer indicated that retention time was approximately one hour. Further analysis of this data will be used to evaluate pond sediment and nutrient removal efficiency as a function of various biophysical characteristics.

Phosphorus sources and transport in CEAP watersheds

1:30 PM – 3:00 PM

Moderator: *Shannon Carpenter, USDA NRCS*

Presentation 1: Phosphorus Sources and Transport in the CEAP Choptank River Watershed: Utilizing Measurement and Modeling to Identify Critical Source Areas - *Maryam Foroughi, Ling Du, Isis S. P. C. Scott, Nicole M. Fiorellino, W. Dean Hively, Cathleen J. Hapeman, Gregory W. McCarty*

Phosphorus (P) poses a persistent challenge in watershed management, especially in agricultural watersheds. The Choptank River CEAP watershed, located on the Delmarva Peninsula (MD, DE) and draining to the Chesapeake Bay, has numerous areas of legacy soil P in its agricultural landscapes. Historical practices of dairy and poultry manure application has resulted in soil P content exceeding crop needs and contributing to persistent P export to sensitive aquatic ecosystems. However, the relationship between topography, spatial P distribution, and landscape properties leading to enhanced legacy P movement by drainage processes remains unclear. A central hypothesis is that water movement within fields transports dissolved and particulate P to lowland and depressional areas with inherent poor drainage. These areas receive focused drainage management by producers which also enhances rapid movement of P-enriched water to receiving waters by way of channelized overland flow or tile drain flow. In collaboration with the USDA Legacy P project, we conducted intensive soil sampling on local farm landscape, collecting soil samples from 100 in-field locations at two depths (0-5 and 5-15 cm) and sediment samples from 14 locations in ditches

adjacent to the production fields. Samples were equally distributed across five topographic openness classes to capture the P concentration variability in different landscape features. The farm has received manure from dairy cattle for >100 years, resulting in elevated soil test P. The primary results indicated that the average available P concentration was 218 and 179 mg kg-1 in 0-5 and 5-15 cm soil depths, respectively, with P in a legacy dairy pasture/feedlot area approximately 100 mg kg-1 higher than the average across other field areas. The correlations (R) between soil P concentration and soil textures (clay and silt) were greater than 0.50 for both depths. Infiltration data showed a positive correlation between Ksat and sand content. In this study, our analysis revealed a significant negative correlation between the topographic openness map and available P content, indicating that areas characterized by higher openness tend to have lower P content. Overall, management history was a major driver of P distribution with significant spatial structure revealed by ordinary kriging. A weaker relationship was observed between landscape and topographic parameters. Furthermore, hydrologic properties of different landscape positions determined the observed engineered drainage management strategies that likely enhanced rapid transport of P via channelized overland flow or tile drainage with surface connection. These findings will inform landscape models for mapping critical source areas within the low-relief landscape of the Choptank River watershed and other watersheds and will assist in identifying critical source areas for P export to implement effective mitigation practices and improve water quality.

Presentation 2: Phosphorus loss from an agricultural watershed as a function of changing rainfall extremes - *Anthony R. Buda, Casey D. Kennedy, David J. Millar, Jonathan M. Duncan, Adrian R. H. Wiegman, Molly K. Welsh, and Louis S. Saporito*

Phosphorus (P) loss from agricultural watersheds is generally dictated by storm size, with large infrequent storms contributing significantly to annual P export. With the acceleration of climate change, the character of these large storms is currently being altered, as growing evidence suggests that the frequency and severity of extreme rainstorms are on the rise. Indeed, the unpredictability of extreme rainfall events poses considerable uncertainty in assessing the efficacy of P management decisions. In this presentation, we examine the effects of extreme rainfall on watershed P loss in the FD-36 watershed, a 0.4 km2 experimental agricultural watershed in east-central Pennsylvania. Emerging evidence from WE-38, the parent watershed to FD-36, shows that the frequency and magnitude of sub-hourly, hourly, and daily rainfall events has risen sharply over the past 55 years, with the largest increases occurring in the spring months when nutrients are being applied to fields. Here, we seek to answer three questions: (1) what is the link between extreme rainfall events and P loss? (2) what time of year do maximum P losses occur relative to maximums in extreme rains, and are the timings of these maximums shifting? (3) what fraction of annual P loss is due to extreme rains? Findings from this study are intended to inform P management in an era of changing rainfall extremes.

Presentation 3: Distinguishing source contributions to phosphorus loads in a small pilot watershed in the Western Lake Erie Basin - *Laura Johnson, Nathan Manning, Austin Nainiger, Kevin King, and Jay Martin*

In response to the continuing harmful algal blooms in the western Lake Erie basin (WLEB) and the lack of reductions in dissolved reactive phosphorus (DRP) loads from the Maumee River feeding these blooms, we began a pilot watershed study in 2023 to assess the amount of conservation

practices needed to reduce DRP losses. Current modeling approaches indicate that a widespread adoption of practices will be needed to reach the 40% reduction targets required to reduce the frequency of severe blooms. Thus, our goal is to implement over 70% of the pilot watershed, Shallow Run, in the headwaters of the Maumee River with conservation practices aimed to reduce loading of DRP (e.g., subsurface fertilizer placement, variable rate nutrient application). Monitoring of hydrology, all major nutrients, suspended sediments, and turbidity began in this watershed in 2018. Water quality samples are collected up to three times per day depending on flow conditions using a refrigerated autosampler and retrieved weekly for laboratory analysis. Like many rural watersheds in the WLEB, sources of DRP in Shallow Run are mixed and consist of agricultural nonpoint sources along with a wastewater lagoon for a small village within the watershed. Hence, we have been considering how to reduce P loads from the lagoon in addition to agricultural fields to meet the DRP load reduction targets. In this study, we calculated nutrient loads with and without lagoon discharge events to assess the effect on annual loads. We found that although discharge events from the lagoon drastically increased DRP concentrations often over 1 mg/L, the contribution to annual DRP loads was minimal (<15%) because of the infrequency of such discharges (~4 times per year). While reducing P loads from wastewater lagoon discharges would improve local water quality, focusing on agricultural nonpoint sources in this and other similar watersheds will have a greater effect on reducing eutrophication of downstream waterbodies.

Presentation 4: Evaluating Conservation Practice Effects at the Watershed- and Field-Scales in the Lake Champlain Basin of Vermont - *Joshua W. Faulkner, G. Harrison Myers, Nisha Nadkarni, Abigail Augarten, Eric D. Roy*

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 updated analysis of water quality data collected will be presented. 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. Results of surface and subsurface monitoring from study fields will be presented, as well as updated performance data for the phosphorus removal structures.

Tools and Modeling in CEAP Watersheds

3:30 PM – 5:00 PM

Moderator: *Claire Baffaut, USDA ARS*

Presentation 1: ACPF enhanced by SVI - *Sarah Porter and John Baker*

The Soil Vulnerability Index was recently added as a geospatial tool into the Agricultural Conservation Planning Framework (ACPF), which offers the ability to utilize a high-resolution slope surface rather than representative slope values published in the USDA Soils Survey Geographic Database. To enable this process, attributes of soil erodibility and hydrologic group for the dominant soil map unit component are combined on a per-pixel basis with a slope surface derived from high-resolution digital elevation data. Since non-dominant components cannot be spatially mapped, their omission from this new approach raises questions about information that may be lost due to their exclusion and the resultant impact on SVI vulnerability estimates. SVI results for surface loss were generated within ten Conservation Effects Assessment Project (CEAP) Hydrologic Unit Code 12 watersheds using three different approaches: 1) a map-unit based approach using all components of each map unit, 2) a map-unit based approach using just the dominant component of each map unit, and 3) a pixel-based approach combining soil attributes from the dominant component of each map unit with a high-resolution slope surface. Results suggest that the omission of non-dominant components has little effect on SVI surface loss vulnerability at the small watershed scale. Significant differences were observed, however, when incorporating a high-resolution slope surface into the SVI classification. An examination of the largest map unit within each watershed found that many of these differences arise because of the crisp nature of the SVI ruleset itself, particularly in map units and watersheds where SSURGO representative slope values fall on a threshold between SVI categories. This suggests that continuous rather than discrete data values are more appropriate for use with a crisp ruleset such as the SVI. The incorporation of high-resolution slope significantly increased the visual interpretation of SVI surface loss at the field-scale, a benefit to conservation planners that likely outweighs any loss of information from non-dominant components, particularly when considering the large size of soil map units and the non-spatial nature of non-dominant components.

Presentation 2: Sediment sources and conservation planning in the Mississippi River Basin - *Patrick Belmont, Janice Brahney, Joe Wheaton, Philip Bailey, Zhen Xu, Lauren Herbine, Shelby Sawyer*

Sediment is a naturally occurring component of river ecosystems, but historic and current land use, as well as changes in climate, have accelerated erosional processes and altered rates of sediment transport and deposition within river networks and their surrounding landscape. Traditional approaches for quantifying sediment sources in river basins and developing landscape-scale conservation and restoration strategies face many logistical problems, data limitations, and financial constraints. This project is working on two major advances in sediment source identification and multi-scale planning of conservation and restoration practices with a focus on the Mississippi River Basin (MRB). First, we have compiled a database containing all available geochemical fingerprinting data throughout the entire Mississippi River Basin (n= 221,109 samples and 3,685,247 geochemical measurements). Our initial analysis of the database found that most MRB studies reported credible fingerprinting results and found near-channel sources to be the dominant sediment sources. Yet, a lack of standardization in methods makes results difficult to compare across all studies. Our findings illustrate that sediment source fingerprinting is a highly valuable and reliable sediment source assessment approach to assist land and water resource management under current management frameworks, but efforts are needed to make this technique applicable in large-scale landscape conservation and restoration efforts. Second, we have developed production-grade landscape-scale geomorphic mapping tools that utilizes the best publicly available topographic data and advanced spatial analysis tools (see http://riverscapes.xyz)

to characterize the many distinct geomorphic environments that exist throughout the extensive stream and river network of the Mississippi River Basin. Our geomorphic analysis provide a basis for determining where distinct erosion, transport and depositional environments exist throughout the vast river network, which is a critical step towards identifying natural versus anthropogenic sediment sources, determining which portions of the river are in a healthy versus degraded condition, and developing heterogeneous, locally informed scaling relations for representing the stream network in future watershed hydro-erosion models in terms of channel width, depth, floodplain connectivity and adjustment capacity.

Presentation 3: Assessing the water quality effects of crop rotation between flooded rice and sugarcane under subsurface water management using the SWAT-MODFLOW modeling approach - *Donghyeon Kim, Xue Bai, Samuel J. Smidt, Jehangir Bhadha, and Young Gu Her*

Crop rotation between sugarcane and flooded rice has provided multiple benefits, including soil conservation and increased crop productivity in the Everglades Agricultural Area (EAA). However, the water quality effects of the crop rotation have yet to be clearly documented. Using an integrated modeling approach, this study aims to quantify how crop rotation impacts nutrient loading to downstream waterbodies under subsurface water management. This study is a part of the USDA-NRCS's Conservation Effects Assessment Project (CEAP), a project conducted by the Institute of Food and Agricultural Sciences (IFAS), University of Florida, at the Everglades Research and Education Center (EREC). We have monitored hydrologic variability using soil moisture sensors placed in the fields and groundwater monitoring wells installed in fields and adjoining ditches/canals. We also have sampled water regularly to understand the spatiotemporal water quality variations. We linked an agro-hydrological model (i.e., Soil and Water Assessment Tool, SWAT) to groundwater flow (i.e., MODFLOW) and water quality models (i.e., Reactive Transport in 3 Dimensions, RT3D) to simulate nutrient transport between the fields and ditches/canals through subsurface flow and its interaction with management practices. The SWAT-MODFLOW-RT3D model provided acceptable accuracy in estimating soil moisture, groundwater levels, and nitrate concentrations observed in the study fields. The model parameters have been being further refined with additional monitoring data collected from the study areas. The preliminary results of the integrated modeling demonstrated that groundwater recharge would increase from June, leading to groundwater level increases. Groundwater recharge was found to increase with crop rotation. The nitrate loading and transport were determined by the hydraulic head differences between the groundwater levels at the fields and the surface water levels at the ditches/canals, which were then controlled by subsurface irrigation practice. We are now trying to identify the optimal application timings and rates of water and fertilizers that can minimize water quality impacts while maintaining the agricultural productivity. The modeling results are expected to help manage water quality efficiently and scale up the findings to the entire EAA.

Presentation 4: Modeling groundwater recharge and hydrologic pathways in the Kaweah Basin, California - *Hoori Ajami, Juan S. Acero Triana, Sandra Armengol, Ray G. Anderson, Dong Wang*

Groundwater has been a major source of fresh water for irrigated agriculture in the water -stressed Western United States. However, excess withdrawals have led to severe depletion in most aquifers including the Kaweah Basin. In California a law was passed in 2014 to mendate groundwater recharge to offset withdrals, yet the hydrologic pathways that control recharge are not well

understood, especially for mountain-valley aquifers such as the Kaweah Basin. Mountain system recharge is important as it represents a significant natural recharge pathway. In this study, a hydro-geological model of the Kaweah Basin was developed and all major natural recharge pathways were calibrated with geochemical observations using ParFlow.CLM, a fully coupled surface-subsurface hydrologic model suitable for simulating groundwater recharge. Results of over 700 years of daily spin-up simulations with an extensive model evaluation using streamflow and groundwater level observations indicate that mountain front recharge and mountain block recharge represent 67% and 33% of total recharge, respectively. Furthermore, remotely-sensed evapotranspiration and snow-water equivalent datasets were used to more accurately represent land surface fluxes. We assessed the influence of irrigation on diffuse recharge and plant water use in the valley aquifer under multiple scenarios of deficit irrigation. Our results are expected to significantly improve understanding of the hydrologic processes, including pathways for groundwater recharge, for the Kaweah Basin. The modeling framework can also be used as a decision-support tool for developing conservation groundwater management practices for growers and state and local water agencies.

Opportunities to Address Environmental Justice Concerns in Conservation Principles

Ballroom C on Main Level

Track: Conservation Economics and Policy

Time: 10:30 AM – 12:00 PM

Moderator: *Naveen Adusumilli, LSU AgCenter*

Authors: *Naveen Adusumilli (LSU AgCenter)*; Joe Williams (USDA NRCS); Gretchen Sassenrath (Kansas State University)*

Conservation practices play an essential role in mitigating the impacts of extreme weather events and anthropogenic influences. They help reduce soil loss, reduce runoff of nutrients, protect water quality, and provide a suite of ecosystem services. Yet, the process of how conservation goals are prioritized, implemented, and measured across agricultural landscapes is often inequitably distributed. Historically marginalized groups and their communities experienced inequity in the distribution of environmental risk, coupled with less attention to the experiences of such affected communities only exacerbated the management of natural resources. Although not a new concept, implementation to address environmental justice issues seems mixed, sometimes not well thought out, consequently resulting in mixed environmental outcomes. Nevertheless, public engagement is considered a promising avenue for addressing such inequities. More recently, agencies took on a much-focused approach in developing programs and activities to address these disproportionate cumulative impacts. Such recognized consideration has high hopes for translating into more equitable outcomes. EJ is yet a relatively nascent topic and understanding the barriers and opportunities to better incorporate EJ into environmental agendas became a central feature at many agencies.

The session aims to bring researchers and policymakers to facilitate a discussion on understanding EJ priorities and how research is driving some of those decisions and avenues for future work in this important space. This proposed symposium will have three speakers followed by a panel discussion.

Collective Competence: How Concepts from the Medical Field Can Improve Collaboration and Organizational Outcomes

Room 106 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 10:30 AM – 12:00 PM

Moderator: *Jean Brokish, American Farmland Trust*

Authors: *Jean Brokish (American Farmland Trust)*; Katherine Sarsfield (Bradley University)*

With increased funding opportunities for conservation efforts, many organizations are growing and trying to recruit the most talented and competent individuals. But what if hiring the most competent individuals isn't enough?

Collective Competence is a concept used in the medical field based on the reality that patient care is dependent on multiple teams and networks of individuals working together in a complex system. A successful outcome for the patient requires each individual to do their job (individual competence) AND to understand how their roles and responsibilities inter-relate with care provided by specialists, lab technicians, staff working the next shift, and others (Collective Competence).

The Midwest Team of American Farmland Trust (AFT) recently explored how Collective Competence can be applied outside of the medical field in partnership with an experienced health care professional and educator. This session will highlight training materials and tools the AFT team used to understand Collective Competence including case studies and discussions on communication styles, surveys to understand conflict management, assessments to identify team member strengths, and simple frameworks to clarify responsibilities. While this effort is ongoing, the Midwest Team has already seen improvements and believes other conservation organizations could gain similar value by incorporating Collective Competence in their work.

NRCS International Programs: Yesterday, Today, and Tomorrow

Room 107 on Main Level

Track: Outreach, Education, and Community Engagement

Time: 10:30 AM – 12:00 PM

Moderator: *Michael Robotham, USDA NRCS*

Authors: *Michael Robotham (USDA-NRCS)*; Chen-Lun Chang (USDA, NRCS); Shelby Callaway (USDA-NRCS)*

Natural Resource Conservation Service (NRCS) staff have been involved in international activities since the 1930s when leaders of the then Soil Conservation Service traveled abroad to spread the messages of soil conservation and soil science, exchange information with international colleagues, and host international visitors in Washington DC and on field visits throughout the country. Although the specific activities have changed over the years, NRCS staff continue to be actively involved in international activities at multiple levels. This symposium will present highlights of the history of NRCS's international involvement along with two panel discussions where NRCS staff will present and discuss current activities including support for multi-lateral initiatives such as the Global Soil Partnership and technical support for specific projects in collaboration with the Foreign Agricultural Service (FAS), the United States Agency for International Development (USAID), and other organizations.

Improving Mitigation Outcome Estimates through the Inflation Reduction Act and USDA: Part 1 - Field Data Collection of Carbon and GHG and Data Management

Ballroom C on Main Level

Track: Climate-Smart Agriculture

Time: 1:30 PM – 3:00 PM

Moderator: *Laura Schreeg, USDA NRCS*

Authors: *Laura Schreeg (USDA)*; Skye Wills (USDA-NRCS); Peter Vadas (USDA/ARS); Virginia Jin (USDA-ARS)*

USDA is working to improve quantification estimates of carbon sequestration and greenhouse gases (GHG) through the Inflation Reduction Act (IRA). Key goals of the work are to:

1) Improve estimates and reduce uncertainties of GHG mitigation outcomes associated with conservation mitigation activities supported through USDA conservation programs

2) Improve the timeliness and reduce uncertainties in the US National GHG Inventory

The IRA GHG Quantification work is a collaborative effort that brings together expertise from the USDA Natural Resources Conservation Service (NRCS), Agricultural Research Service (ARS), Economic Research Service (ERS), National Agricultural Statistics Service (NASS), and the Office of the Chief Economist (OCE) Office of Energy and Environmental Policy (OEEP) and other agencies and partners.

The work is broadly divided into two categories - 1) improving data and 2) using the data to improve model estimates. The effort is organized through seven action areas that support USDA's broader Measurement, Monitoring, Reporting, and Verification portfolio.

This symposium will cover the action areas on field data collection and data management

• Action Area #1: Establish and advance a Soil Carbon Monitoring and Research Network with a perennial biomass component

• Action Area #2: Establish and advance a Greenhouse Gas Research Network

• Action Area #3: Expand data management, infrastructure, and capacity

The broader impacts of this work include advancing the Inventory of U.S. Greenhouse of Emissions and Sinks for international reporting to the United Nations, providing critical information for guiding conservation investments by the Natural Resources Conservation Service, and sharing robust data sets for researchers to use (following data privacy statutes) in advancing our understanding of the impact of management on GHG mitigation.

In this session, the presentations on Action Area #1 (carbon data) and Action Area #2 (GHG data) will outline protocols and sampling designs, along with initial data collection efforts. Outreach to USDA has demonstrated significant interest in the planned and initial work for the Action Areas and the symposium is excellent opportunity to discuss with conference participants.

Overcoming Barriers to Solving Flooding Concerns While Fostering Collaboration for Positive Environmental Impact

Room 106 on Main Level

Track: Conservation Models, Tools, and Technologies

Time: 1:30 PM – 3:00 PM

Moderator: *Chuck Brandel, ISG*

Authors: *Chuck Brandel (ISG)**

This presentation will illustrate a pioneering approach to drainage projects, emphasizing a paradigm shift that addresses both landowner and environmental concerns. By incorporating large wetland and storage practices, the mitigation approach provides sustainable solutions, simultaneously meeting the needs of landowners while promoting environmental stewardship. The session will underscore the critical need for additional funding to sustain and scale this approach, with the potential to significantly impact flood reduction and water quality.

National Agricultural Drainage Expert, Chuck Brandel, PE, will lead a discussion on challenges that currently hinder drainage implementation in Minnesota. These challenges include opposition from environmental action groups, public perception of agricultural practices, complicated granting processes, and the demanding cost/benefit ratio criteria that exclude water quality as a qualifying benefit. The presenter will explain how ISG has navigated these obstacles, showcasing several successfully funded projects and examining their impacts on landowners, the industry, and the environment.

As an increasing number of companies adopt Net Zero Carbon goals, opportunities for collaboration emerge. The presenter will delve into strategies for engaging with public and private entities that are actively seeking partnerships with farmers and firms committed to environmental stewardship. By exploring large-scale water quality initiatives, the session demonstrates how collaboration can contribute to achieving common goals and align with corporate sustainability objectives.

By highlighting real-world examples and encouraging active participation from attendees in developing new ideas to overcome barriers, the presenter will inspire further support and investment in sustainable drainage projects that yield tangible benefits for all stakeholders. As part of the symposium there will be interaction between the presenter and the attendees including a workbook to review and answer questions to discuss what sustainable approaches are being used throughout the country and what challenges are needed to be overcome to implementation.

A panel of experts, including Heidi Peterson, Ph.D., Vice President of the Sand County Foundation, and Chad Klotzbach from Alleghany Farm Services, will share their perspectives on the issues from their respective fields. This approach will facilitate interaction between the presenter, attendees, and panelists.

Adapting Together: Building Community and Effective Networks

Room 107 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 1:30 PM – 3:00 PM

Moderator: *Women in NRCS Professional Organization (WiN)*

Authors: *Bernadette VM Mills (NRCS)*; Katie Cerretani (WiN); Jessica Rock (WiN)*

For someone feeling isolated or unable to connect with their peers, a professional network can be a lifeline. These organizations foster connections, provide training, and support growth for their members. They can also connect people who are struggling with similar problems and link people with resources. However, it can be a challenge to establish and maintain these types of communities over time and often across dispersed geographies. Presenters will draw upon their breadth of experience to share strategies for establishing networks, creating space for meaningful connection, collaborating in a virtual environment, and supporting members through mentoring. WiN has been building its community to support women in the field of conservation for over a decade. In recent years, membership has grown and evolved to include a formal mentoring program to further support its members. American Farmland Trust's Women for the Land Learning Circles create peer-to-peer spaces for women in agriculture to share expertise and experiences, while connecting with resources that can assist them in navigating challenges. By coordinating resources to reduce and respond to stress, the SAgE Network supports the well-being of people and families in agriculture. The SAgE Newtork partner Virgin Islands Good Food bridges the gaps between food system stakeholders and leverages resources to build food security. SWCS has been supporting conservation professionals since its founding in the 1940s. Its Emerging Leaders Program is now nurturing the next generation of conservation leaders to foster resilient professionals capable of addressing modern conservation challenges. Participants in this symposium will come away with tools to set themselves and their networks up for success and inspiration to keep our conservation community thriving.

Benchmarking Soil Health Across North America
Room 108 on Main Level

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

Time: 1:30 PM – 3:00 PM

Moderator: *Cristine L.S. Morgan, Soil Health Institute*

Authors: *Cristine L.S. Morgan (Soil Health Institute)*; Amber Leusink (Truterra); Jenny Bower (Soil Health Institute); Ayush Gyawali (Soil Health Institute); Nara Cloutier (Soil Health Institute)*

Collecting effective, interpretable soil health measurements across soil types and management practices is an essential step towards helping land managers set and achieve soil health goals. The Soil Health Institute and its partners, such as Truterra, the Greenbelt Foundation, and the US Cotton Trust Protocol, have endeavored to benchmark soil health potential and improvements that producers have already achieved across North America. The Institute is collecting data using the minimum suite of recommended measurements, including organic carbon concentration, wet aggregate stability, and carbon mineralization potential, along with soil texture. These indicators are measured across an a priori map of soil groups identified to have similar soil health potential, and across regionally representative management categories, which include, baseline crop production systems, soil health management systems, and reference systems that express the soil health principles such as maximizing living roots and minimizing disturbance. In this symposium, we will present (1) the theory behind our scalable, measurement-based approach that provides locally relevant soil information, (2) measurement results from four agroclimatic regions, and (3) a multipronged communication strategy for putting benchmarks in the hands of producers, crop consultants, and retailers.

Improving Mitigation Outcome Estimates through the Inflation Reduction Act and USDA: Part 2 - Advancing Activity and Program Data and Improving Models and Tools

Ballroom C on Main Level

Track: Climate-Smart Agriculture

Time: 3:30 PM – 5:00 PM

Moderator: *Laura Schreeg, USDA NRCS*

Authors: *Laura Schreeg (USDA)*; Elizabeth Marshall (USDA OEEP); Amanda Moore (USDA NRCS); Jonathan Smith (USDA NRCS); Casey Sheley (USDA NRCS); Terron Hillsman (USDA NRCS); Claire Boryan (USDA NASS); Maria Bowman (USDA ERS); Mindy Selman (USDA OEEP)*

USDA is working to improve quantification estimates of carbon sequestration and greenhouse gases (GHG) through the Inflation Reduction Act (IRA). Key goals of the work are to:

1) Improve estimates and reduce uncertainties of GHG mitigation outcomes associated with conservation mitigation activities supported through USDA conservation programs

2) Improve the timeliness and reduce uncertainties in the US National GHG Inventory

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The work is broadly divided into two categories - 1) improving data and 2) using the data to improve model estimates. The effort is organized through seven action areas that support USDA's broader Measurement, Monitoring, Reporting, and Verification portfolio.

This symposium will cover the action areas on advancing activity and program data, and improving models and tools:

• Action Area #4: Improve models and tools for assessing outcomes at operational, state, regional, and national scales

• Action Area #5: Improve NRCS conservation practice standards and implementation data to reflect GHG mitigation opportunities

• Action Area #6: Improve temporal and spatial coverage of national conservation activity data

• Action Area #7: Advance Greenhouse Gas Inventory and Assessment Program of USDA

The broader impacts of this work include advancing the Inventory of U.S. Greenhouse of Emissions and Sinks for international reporting, providing critical information for guiding conservation investments by the Natural Resources Conservation Service, and sharing robust data sets for researcher to use (following data privacy statutes) in advancing our understanding of the impact of management on GHG mitigation.

Outreach to USDA has demonstrated significant interest in the planned and initial work for the

Action Areas and the symposium is excellent opportunity to discuss with conference participants.

The Clean Water State Revolving Fund: What is It and How to Access Its Affordable Financing Options for Water Quality Improvement Projects

Room 106 on Main Level

Track: Conservation Economics and Policy

Time: 3:30 PM – 5:00 PM

Moderator: *Ellen Tarquinio, US EPA*

Authors: *Michael Deane (U.S. Environmental Protection Agency); Ellen Tarquinio (U.S. Environmental Protection Agency); Karen Sughrue (U.S. EPA)**

Funding through the U.S. Environmental Protection Agency's (EPA) Clean Water State Revolving Fund (CWSRF) and the Bipartisan Infrastructure Law (BIL) represent a tremendous financial investment opportunity for the conservation community. Farmers, conservation districts, nonprofits and communities across the country are all realizing savings and environmental benefits with CWSRF financing. Many conservation districts are using ongoing CWSRF funding to scale-up these efforts.

This symposium will highlight these opportunities and more that can be achieved through utilization of CWSRF. The CWSRF program provides low-cost financing for a wide range of water quality improvements, including sustainable forestry projects and agricultural best management practices such as feedlot runoff control, stream exclusion fencing, manure management, conservation tillage and erosion control. In this symposium, EPA will provide an overview of the CWSRF program, highlight the additional funding opportunities available through BIL, and provide examples of resource conservation success stories. A representative from the Virginia Department of Environmental Quality will also provide an insider's perspective on the diverse funding opportunities available through a state CWSRF program. The third portion of the symposium will be a presentation on the water technical assistance available through the EPA's Environmental Finance Centers (EFC). A representative from the Delta Institute, an EPA Region 5 Water Infrastructure EFC, will discuss the role EFCs have in assisting communities across the country to access CWSRF funding, as well as present the types of the technical support they can provide to farmers and businesses making the transition to more sustainable and regenerative practices. The symposium will close with an interactive question and answer session with the audience.

How NRCS Can Assist with Issues in Your Watershed: We Can Do More than Build Dams!

Room 107 on Main Level

Track: Cultivating Conservation Technical Assistance, Community, and Networks

Time: 3:30 PM – 5:00 PM CT

Moderators: *Diana L. Sheridan, USDA NRCS and Sonya Keith, USDA NRCS*

Authors: *Diana L Sheridan (NRCS)*; Sonya Keith (NRCS)*

Many people are unaware that the Natural Resources Conservation Service (NRCS) has been at the forefront of assisting communities to address watershed scale issues by cultivating conservation through technical and financial assistance since August of 1954. Congress recognized the serious natural resources and economic damages in our nation's watersheds from flooding and sedimentation and passed Public Law 83-566 (PL-566) to address these concerns.

Those who have heard about PL-566 may think of it as the "Dam Building" program, but this program can be utilized to do so much more. PL-566 authorizes NRCS to engage with sponsoring local organizations to address watershed scale issues including flooding, irrigation, conservation measures for water quality, wildlife habitat, and more. Recently, there has been a renewed interest in Watershed Planning with projects currently funded by the Bipartisan Infrastructure Bill.

Assistance starts at the community level with a request to NRCS. Qualifying projects that receive funding have access to NRCS technical and financial assistance to work with local communities and partners. PL-566 project success hinges on local leadership and are planned and carried out jointly by local, state, and federal agencies with support of community landowners and citizens in the watershed.

This symposium will cover the PL-566 Watershed Protection and Flood Prevention, the Watershed Rehabilitation Program and Watershed Planning. The presenters from NRCS Watershed Program Branch and Conservation Engineering Division National Water Management Center, will lead the audience through the process providing ample interaction to answer audience questions. This symposium aims to provide insight on each phase of the process and illustrate how NRCS may be able to help through planning, design, and implementation (construction) of a project. PL-566 projects are the perfect case study for Collaborative Conservation.

Emerging Leaders Lighting Talks: Insights and Impact

Room 108 on Main Level

Track: Outreach, Education, and Community Engagement

Time: 3:30 PM – 5:00 PM

Moderators: *Soil and Water Conservation Society Emerging Leaders*

Authors: *Soil and Water Conservation Society Emerging Leaders*

This session is led by members of the 2024 Class of SWCS Emerging Leaders Program. These leaders will deliver lightning presentations sharing their experiences, lessons learned, and the impact of their conservation events. From innovative events to community-building initiatives, each presenter will provide insights into their work and its significance in the conservation field. The session will also include an interactive question and answer section, allowing attendees to engage directly with these early-career professionals. Don't miss this opportunity to be inspired by the next generation of conservation leaders and discover how they are making a difference.

WEDNESDAY, JULY 24

SYMPOSIA SESSION DESCRIPTIONS AND AGENDA

Using Ag Retailers to Deliver Wholesale Conservation

Room 106 on Main Level

Track: Conservation Models, Tools, and Technologies

Time: 8:30 AM – 10:00 AM

Moderator: *Alex Echols, Campbell Foundation*

Authors: *Alex Echols (Campbell Foundation)*; Roger R Wolf (Iowa Soybean Association); Clare L Lindahl (Soil and Water Conservation Society)*

The traditional approach to agricultural conservation adoption requires one-on-one outreach to farmers to persuade them to adopt conservation actions. Three key impediments to this approach are: 1) the conservation advocate oftentimes is not a well-known or trusted partner of the ag producer; 2) is not familiar with the specific farm needs or expert on innovations in technology; and 3) the conservation proponent is principally advancing a good conservation action rather than something to support farm income. Shifting to a conservation delivery model that focuses on meeting farmer priorities by engaging agricultural retailers can change this dynamic.

While the vast majority of farmers have a strong land ethic, only a minority are adopting comprehensive conservation management. We need to develop a conservation delivery model that moves beyond reaching early adopters to reach the vast majority of producers. Putting conservation into the profitability equation for both the farmer and the agribusiness that serves that farmers, changes how farm management decisions are made.

Input suppliers are commonly the last entity a producer talks to before making a decision on how to manage their nutrients. Historically, it has been in the supplier's interest to sell more product, but this role is changing. Today the most important priority to the retailer is to protect their relationship with the customer – the farmer. Maintaining and adding value to the farmer is key to the business success of the ag retailer. As such, retailers are increasingly focusing on how to improve farm profitability instead of increasing the sale of inputs.

This symposia will review economic research and pilot projects using this market outreach approach and discuss a new conservation framework that is being added to the conservation toolbox.

Symposia Outline:

Why ag retail and farmer advisors are important for accelerating conservation practice adoption

How can businesses do this – case studies on how conservation agronomist positions can be structured
How can/does retail conservation show up in a business plan
How can we better encourage this evolution: An overview of a shared Conservation Agronomy Strategic Roadmap, followed by a panel discussion with the audience

Rooted in Service: Growing Customer Experience Skills for Natural Resource Professionals

Room 107 on Main Level

Track: Outreach, Education, and Community Engagement

Time: 8:30 AM – 10:00 AM

Moderator: *Women in NRCS Professional Organization (WiN): Christine Hall, USDA NRCS; Abenu Apau, USDA FPAC; Jennifer Dempsey, USDA FPAC*

Authors: *Bernadette VM Mills (NRCS)*; Jessica Rock (WiN); Kristie McKinley (WiN)*

Customer experience (CX) is a buzzword term you've probably heard used more and more in daily business. But what does it really mean and why should you, as a natural resources professional, care about it? According to Salesforce data collected, 88% of customers say experience matters as much as a company's actual products or services offered. Learning good CX skills can positively impact you and the customers you serve.

This workshop, presented by the United States Department of Agriculture's Farm Production and Conservation (FPAC) Mission Area, aims to help you truly look through your customer's unique lenses to better understand and meet their needs. Participants will learn how to transform their ideas of traditional "customer service" into fostering an overall "customer experience" by learning the following.
• Understanding of what CX is and why it's important,
• The difference between customer service and CX,
• How to apply CX in a natural resource setting including highlighting successful CX projects implemented at FPAC agencies,
• The benefits of good CX and ways to improve it,
• Checking assumptions and biases while understanding your unique lens and the lenses of others, and
• Gaining an introduction to human-centered tools, such as customer personas and journey maps, to better understand customer segments and pain and gain points.

Successful CX-focused businesses look through the customer lens using a process called human-centered design to understand customer's unique emotions, perceptions, and opinions of the products and services they offer. If businesses focus on streamlining and building products and services to better meet customer's needs, they directly build brand trust and loyalty, nurturing customers through their journey and graduating them to customer advocates. Clients deserve streamlined services across multiple platforms, simplified processes, plain language products and equitable programs that meet the unique needs of today's natural resource customers.

By learning tailored CX approaches to communication, problem-solving, and client engagement, participants will walk away with a deeper understanding of how they can best evaluate their customer needs. By attending this transformative workshop, participants will learn practical tools to empower themselves in delivering exceptional service, ultimately strengthening client relationships, fostering client trust, and contributing to the overall success of natural resource

initiatives. Who wouldn't want to improve their skills, build lasting connections with customers, and get at the heart of customer-centered work through CX.

CEAP Wetlands: Remote Sensing and Modeling to Assess Wetland Functions in Agricultural Landscapes *Room 108 on Main Level*

Track: Water Resource Assessment and Management

Time: 8:30 AM – 10:00 AM

Moderators: *Joseph Prenger, USDA NRCS*

I. Extracting Drainage Ditch Networks in Agricultural Landscapes Using Lidar and Deep Learning

Presenter: Ling Du, University of Maryland, ARS Hydrology and Remote Sensing Laboratory
lingdu90@gmail.com

Authors: Ling Du [1, 2], Gregory W. McCarty [2], Xia Li [3], Xin Zhang [4], Martin C. Rabenhorst [1], Megan W. Lang [5], Zhenhua Zou [6], Xuesong Zhang [2], Audra L. Hinson[2]

[1] Department of Environmental Science & Technology, University of Maryland, College Park, MD 20742, USA; lingdu@umd.edu; mrabenho@umd.edu
[2] Hydrology and Remote Sensing Laboratory, USDA-ARS, Beltsville, MD 20705, USA; greg.mccarty@usda.gov; xuesong.zhang@usda.gov; audra.hinson@usda.gov
[3] Advanced Institute of Natural Sciences, Beijing Normal University, Zhuhai 519087, China; lixiabnu@bnu.edu.cn
[4] Department of Computing and Mathematics, Manchester Metropolitan University, Manchester M1 5GD UK; x.zhang@mmu.ac.uk
[5] U.S. Fish and Wildlife Service National Wetlands Inventory, Falls Church, VA 22041, USA; megan_lang@fws.gov
[6] Department of Geographical Sciences, University of Maryland, College Park, MD 20742, USA; zhzou@umd.edu

Within the Chesapeake Bay Watershed, small, channelized drainage networks are very common, which are extensive anthropogenic features constructed for wetland drainage. These ditch networks frequently modify the connectivity of headwaters and play an important role in transport of water and nutrients from poorly drained wetlands to downstream waters. Identifying the location of these drainage ditches can help define where wetlands have been drained and evaluate impacts of artificial drainage patterns on watershed hydrology and biochemical cycles. However, traditional approaches to extract channel networks still have challenges in accurately identifying small headwater ditches, especially in low relief landscapes, and commonly used stream datasets provide limited information on agricultural ditches. In this study, we employed Deep Convolutional Neural Networks (DCNN) based on U-Net architecture to extract drainage ditches within the Delmarva area using lidar data. We found that the DCNN model had significantly higher accuracy for ditch extraction compared to typical machine learning methods (i.e., random forest) and demonstrated the importance of topographic features in ditch identification. The connected drainage ditch network based on DCNN also outperformed the flowlines derived from typical flow routing method (D8), the GeoNet tool, and the National Hydrography Dataset (NHD) High Resolution dataset at 1:24,000 scale. Overall, this study demonstrates the utility of deep learning approaches for

automated extraction of ditch networks and the contribution of lidar-derived topographic data for operational drainage network mapping at local and regional scales.

II. Not All Wetlands are Created Equal: Climate and Landscape Controls over Nutrient Reduction Potential of Wetlands in North Central US Croplands

Presenter: Owen McKenna US Geological Survey Northern Prairie Wildlife Research Center omckenna@usgs.gov

Owen McKenna[1*], Luca Doro[2], Joseph Prenger[3], Brianna Henry[3], Rebecca Kreiling[4], Charles Kimsal[1]
[1]US Geological Survey, Northern Prairie Wildlife Research Center
[2] Blackland Research and Extension Center, Texas A&M AgriLife Research
[3] US Department of Agriculture, Natural Resources Conservation Service, Resource Inventory and Assessment Division
[4] US Geological Survey, Upper Midwest Environmental Science Center

Billions of dollars have been invested in the US towards wetland conservation, restoration, and creation to enhance water quality both in croplands and adjacent downstream waters. Each wetland conservation action is implemented at a very local scale, mainly to conserve, restore, or create small (< 1 ha) waterbodies. There is still great uncertainty about the cumulative landscape-scale nutrient reduction benefits provided by wetlands in croplands and modeling tools are generally top-down estimations of water quantity and quality that are not spatially explicit at the field-scale. In the US Prairie Pothole Region (USPPR; Montana, North Dakota, South Dakota, Minnesota, Iowa), there are an estimated 2.6 million seasonally and temporarily inundated wetlands and 63% of those are embedded within or adjacent to croplands. We used Agricultural Policy/ Environmental Extender (APEX), a field-scale, process-based model to simulate nutrient, sediment, and surface water transport with and without wetlands in 900 standardized 16-ha fields using field management data from the Conservation Effects Assessment Project (CEAP) and daily precipitation and temperature inputs. We found that when an average sized wetland (~1 ha) remains in a standardized 16-ha field, water is reduced by 5%, sediment by 16%, Total N by 34%, and Total P by 21% per year over a relatively wet 30-yr period (1993-2022). We also found patterns of sediment reduction variability that are associated with the geologic and climatic variability across the USPPR. Across the five ecoregions in our study, sediment reductions were as high as 28% (Prairie Coteau, MN/SD) and as low as 7% (Red River Valley, MN/ND) with wetlands in place. When attempting to quantify the role of cropland-embedded wetlands, process-based models can allow for more spatially explicit results.

III. Modeling downstream attenuation of wetland-mediated nitrate reductions

Presenter: Charles Lane USEPA Office of Research and Development lane.charles@epa.gov

Authors: Rebecca Forgrave[1], Grey R. Evenson[2], Heather E. Golden[3], Jay R. Christensen[3], Charles R. Lane[4], Qiusheng Wu[5], Ellen D'Amico[6], Joseph Prenger[7]

[1] Oak Ridge Institute for Science and Education (ORISE) Research Participation Program, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, USA
[2] Lynker, Columbus, OH, USA
[3] Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, USA

[4] Office of Research and Development, U.S. Environmental Protection Agency, Athens, GA, USA
[5] Department of Geography, The University of Tennessee, Knoxville, TN, USA
[6] Pegasus Technical Services, Inc. c/o Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, USA
[7] Natural Resources Conservation Service, U.S. Department of Agriculture, Beltsville, MD, USA

Connections between agricultural runoff and excess nitrogen in the Upper Mississippi River Basin are well-documented, as is the potential role of constructed wetlands in mitigating this surplus nitrogen. However, limited knowledge exists about the "best" placement of these wetlands for downstream nitrogen reductions within a whole watershed context as well as how far downstream these benefits are realized. In this study, we simulate the cumulative impacts of diverse wetland restoration scenarios on downstream nitrate reductions in different subbasins of the Raccoon River Watershed, Iowa, USA, and spatially trace their relative effects downstream. Our simulated results underscore previous work demonstrating that the total area of wetlands and the wetland-catchment-to-wetland area ratio are both significant factors for determining the nitrate load reduction benefits of wetlands at subbasin scales. However, we found these wetland-mediated nitrate reduction benefits are quickly attenuated downstream throughout the watershed, despite the magnitude of the subbasin-scale nitrate decreases. The relatively rapid attenuation of wetland effects is largely due to downstream nitrate load contributions from untreated subbasins. In general, higher subbasin-scale nitrate reductions from wetland-based conservation practices resulted in longer downstream distances prior to attenuation. This study highlights the importance of considering the spatial location of constructed or restored wetlands relative to the area within the watershed where nitrogen reductions are most needed.

IV. Use of MESA as a Tracer for Agricultural Nitrate Runoff in US Wetlands

Presenter: Kim Van Meter Penn State University vanmeterKVM@psu.edu

The nitrogen (N) cycle continues to accelerate with the widespread use of N fertilizers, growing numbers of concentrated animal feeding operations, atmospheric N deposition from fossil fuel combustion, and increasing human populations. Growing magnitudes of surplus N in agricultural landscapes have led to contamination of drinking water and increased export of N to coastal regions, where ecosystems are degraded through the uncontrolled growth of algae, reductions in oxygen levels, and subsequent disruption of aquatic food webs. While it is known that wetlands can reduce nitrate concentrations from agricultural runoff, thus contributing to water quality improvements, it remains difficult to quantify the extent to which wetlands can reduce nitrate concentrations and thus improve water quality. Here, we are using MESA (metolachlor-ethane sulfonic acid)—a metabolite of the widely used herbicide metolachlor—as a novel tracer of agricultural N fluxes to wetlands, with the goal of developing better spatially explicit predictions of N sources to wetlands, of providing better estimates of the *magnitudes* of agricultural N reaching current and restorable wetlands, and of more accurately quantifying N removal rates and related nitrous oxide emissions. Here, we will discuss current progress in both our large-scale analysis of MESA occurrence in more than 600 US wetlands, as well as our site-specific analysis of time-varying concentrations of MESA and nitrate in agricultural wetlands.

USDA Southeast Climate Hub-Developing and Delivering Climate Smart Decisions

Room 106 on Main Level

Track: Climate-Smart Agriculture

Time: 10:30 AM – 12:00 AM

Moderator: *Christopher F. Miller, USDA NRCS*

Authors: *Christopher F Miller (USDA-NRCS)*; Michael J Gavazzi (USDA Forest Service); Steve McNulty (USDA Forest Service); Justin Beslity (USDA-Forest Service)*

The USDA Climate Hubs are a collaboration of several USDA agencies including the Agricultural Research Service (ARS), the Forest Service (FS), and the Natural Resources Conservation Service (NRCS). The Climate Hubs form a network of more than 120 climate researchers and communicators who work across the USDA and with partners to support climate-informed decisions. These Hubs were established in 2014 to develop and deliver science-based, regionally specific information and technologies for agricultural, forest, and natural resource managers and communities. The Climate Hub's activities facilitate and support climate-informed decisions for robust, healthy, and resilient working lands. An International Climate Hub was added in 2023 to collaborate and share best practices with international partners for improvement of working land resiliency to climate change and to mitigate climate impacts across the globe. USDA Climate Hubs accelerate the development of science-based solutions; inform deployment of adaptation strategies; build tools for farmers, ranchers, and foresters to make climate smart management decisions; and to assure the just treatment and meaningful involvement of all people impacted by climate change.

This session will focus on priorities of the Southeast USDA Climate Hub relative to providing information and tools on mitigation and adaptation to saltwater intrusion from coastal flooding, applying climate smart forestry practices, building forest resilience to hurricanes, and reducing disturbance risk through proper tree species selection.

Truterra's Climate SMART Project: A Retailer-led Approach to Conservation Delivery

Room 107 on Main Level

Track: Climate-Smart Agriculture

Time: 10:30 AM – 12:00 PM

Moderator: *Joe Otto, Truterra*

Authors: *Joe Otto (Truterra)*; Amber Leusink (Truterra); John Porter (Truterra)*

This symposium features panelists working on the Climate SMART (Scaling Mechanisms for Agriculture's Regenerative Transformation) led by Truterra – the sustainability business of Land O'Lakes, Inc. Truterra's Climate SMART Project is part of NRCS's Partnership for Climate Smart Commodities initiative. Awarded in 2023 and running through 2028, the project aims to deliver technical and financial assistance to producers and their service providers so to encourage the adoption of cover cropping and no-till. Led by Truterra project personnel and its project partners, this symposium includes an overview of the Climate SMART project, its core programmatic elements, and activities related to the engagement of Historically Underserved Producers.

CEAP Wetlands II: Assessing Ecosystem Services of Wetland Conservation in Agricultural Landscapes

Room 108 on Main Level

Track: Water Resource Assessment and Management

Time: 10:30 AM – 12:00 PM

Moderator: *Joseph Prenger, USDA NRCS*

I. Soil Organic Carbon Variability and Ecosystem Services in Wetland and Riparian Ecosystems of Highly Agricultural Landscapes

Presenter: Audra Hinson USDA ARS Hydrology and Remote Sensing Lab audra.hinson@usda.gov

Authors: Audra L. Hinson[1], Greg McCarty[1], Ling Du[21], Martin Rabenhorst[2], and Xuesong Zhang[1]
Affiliations: [1]Remote Sensing and Hydrology Laboratory, USDA Agricultural Research Service, Beltsville, MD, USA
[2]Department of Environmental Science & Technology, University of Maryland, College Park, MD 20742, USA

While wetlands are some of the most effective and critical ecosystems for soil organic carbon storage and sequestration, the recovery of soils and the capacity for carbon sequestration in restored wetlands has been variable and sometimes reported as ineffective. Yet still, conservation easement programs focus on restored wetlands' ability to sequester carbon as a co-benefit to other ecosystem services and as a notable climate mitigation tool. In this study, we aim to characterize the carbon ecosystem services of protected wetlands and estimate the recovery time for restored carbon ecosystem services in a highly agricultural landscape. Using a comprehensive database of USDA conservation easements, we estimated the soil carbon ecosystem services for protected wetlands and riparian ecosystems in the highly agricultural area of the Delmarva Peninsula in the Mid-Atlantic United States. Only 4% of the total wetland and riparian land on the Peninsula is currently protected, even though the Delmarva area is in one of the most extensively conserved regions within the United States. Using our unique geodatabase of all USDA conservation easements, we calculated the carbon ecosystem services provided by conservation easements on the Delmarva. In total, we found that protected wetland and riparian areas of the Delmarva store approximately 1.88 Tg of soil organic carbon in the upper 50 cm. We also evaluated the carbon sequestration potential of the area's restored wetlands, estimating the time required for wetland soils to recover to be on average 45 years, with a median of 32 years. Both recovery time estimates are within the time frame of many conservation land contract lengths, especially considering renewals. Hence, depressional wetlands and riparian lands can be important for both climate mitigation and carbon ecosystem service provision. The focus of current wetland conservation programs on long-term easements will enhance provision of these key ecosystem services.

II. Restoring diverse vegetation and hydrology can optimize nutrient retention recovery in agricultural floodplain wetlands in Tennessee and Kentucky

Presenter: Justin Murdock Tennessee Tech University jnmurdock@tntech.edu

Authors: Justin Murdock[1], Robert Brown[1,2], Shrijana Duwadi[1,3], and Spencer Womble[1,4]

Affiliations: [1]Department of Biology, Tennessee Technological University, Cookeville, TN
[2] Oak Ridge Institute for Science and Education, US Environmental Protection Agency, Corvallis, OR
[3] Department of Life and Environmental Sciences, University of California, Merced, CA
[4] Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA

Wetland restorations have historically centered on returning wetland soil, hydrology, vegetation, and wildlife to a pre-disturbed state, but there is increasing interest in reestablishing ecosystem services such as nutrient retention and carbon storage. However, as pre-disturbed functional rates are often unknown, goals often default to maximizing processing rates. We conducted an intensive space-for-time assessment of the maximum nutrient retention potential of 35 restored floodplain agricultural wetlands enrolled in the USDA Natural Resources Conservation Service's Wetlands Reserve Program in Tennessee and Kentucky. Wetland ages ranged from 0 to 23 years post-restoration. Mean nitrogen (N) and phosphorus (P) retention rates were greatest in restorations less than 10 years old, but rates in young wetlands were also substantially more variable with some acting as nutrient sources during floods. There were distinct recovery trends among wetland sub-habitats and hydrology regimes, but N and P retention rates stabilized within and across all wetlands from 10 – 23 years post-restoration, coalescing into a state of consistent, but lower removal rates. Multi-objective modeling showed that no single restoration practice maximized both N and P retention, but a mosaic of vegetation types and hydrologic regime may hasten functional recovery. These results suggest that floodplain wetland nutrient retention in the Lower Mississippi River Basin can recover very quickly, but it can take a decade or more for wetlands to setting into a consistent pattern of removal. More work needed to isolate the mechanisms that cause retention variation in young wetlands, as well as to determine how other services such as carbon storage recover across restoration practices.

III. Greenhouse gas emissions in WRP restorations linked to hydrology.

Presenter: Tracey Schafer University of Florida tschafer25@ufl.edu

Authors: Tracey Schafer[1], Joseph Prenger[2], and Todd Z. Osborne[1]
Affiliation: 1. University of Florida, 2. USDA Natural Resources Conservation Service

ABSTRACT
Freshwater wetlands are known to emit greenhouse gases, such as carbon dioxide (CO_2) and methane (CH_4), at varying rates dependent on substrate type, quality and hydrology. The Wetland Reserve Easement (WRP/WRE) programs restore freshwater wetlands in agricultural areas to reestablish missing wetland function. The majority of these wetlands provide various ecosystem services, such as wildlife habitat and carbon capture, however, the loss of carbon through CO_2 and CH_4 emitted from these restored wetlands has not previously been thoroughly examined. In order to do so, ten semi- permanent sites have been established within a ranch and nearby reserve containing WRP/WRE wetlands in south-central Florida. Every 2 months, CO_2 and CH_4 flux measurements are taken with a LI-8100 at each site in addition to groundwater and surface water monitoring. Findings generated in the first 6 months of a 2-year project indicate that hydrology and residence time of water within the wetlands is the determining factor in dominant greenhouse gas generating processes. Well-drained or ephemeral wetlands could lose carbon as sources of CO_2 and poorly-drained wetlands have redox conditions low enough to support production of CH_4, which also varies seasonally. Although the benefits of carbon storage in wetlands outweigh any impacts

from greenhouse gas emissions, taking flow and inundation time of wetlands into account with WRP/WRE wetlands could help to capture larger amounts of carbon and mitigate seasonal carbon losses.

IV. Estimating net phosphorus retention in restored riparian wetlands within Vermont's agricultural landscape.

Presenter: Eric Roy University of Vermont eric.roy@uvm.edu

Co-Authors: Tiffany Chin, Rebecca Diehl, Kristen Underwood
Affiliation: University of Vermont

Poor and declining water quality in Lake Champlain and increasing frequency of extreme flood events in the Lake Champlain Basin pose threats to both residents and aquatic ecosystems. Riparian wetlands and floodplains can help address these threats by slowing floodwaters, trapping sediment, and serving as nutrient sinks. The Wetlands Reserve and Agricultural Conservation Easement Programs have invested millions of dollars to protect and restore wetlands in the basin. This presentation will focus on the Vermont CEAP Wetlands research project, the primary objective of which is to quantify the water quality benefits that accrue from restoration of riparian wetlands in terms of phosphorus (P) load reductions. While wetlands are generally known to be phosphorus sinks, data are relatively scarce for restored riparian wetlands on formerly farmed land, where legacy P can potentially be released in dissolved form during inundation. We have monitored water quality during numerous flood events on five such wetlands in Vermont since 2022, including a historic flood in July 2023. Using a combination of field monitoring, soils analysis, laboratory incubations, and modeling, we can estimate net P retention for various scenarios at each site that represent a range of plausible hydrologic and biogeochemical conditions. Preliminary results suggest positive net P retention at all monitoring sites, with site hydrology, soil P storage capacity, and influent river water quality being key factors in determining the balance between P capture and release. Our findings will inform ongoing efforts to reduce watershed P loads, estimate the water quality benefits of wetland and floodplain restoration, and refine the design of restoration plans to achieve intended water quality benefits.

ORAL PRESENTATIONS

MONDAY, JULY 22

ORAL PRESENTATION DESCRIPTIONS AND AGENDA

Subject: Conservation Economics and Policy

Location: Room 202 on Upper Level

Time: 10:30 AM - 12:00 PM

Advancing the Business Case for Soil Health: Insights from On-Farm Assessment at a National Scale

Authors: *Emily Bruner (Soil Health Institute)*; Ann Marie Calabro (Soil Health Institute); Archie Flanders (Soil Health Institute)*

This session will highlight the economics of soil health management systems (SHMS), leveraging results from national-scale assessments conducted by the Soil Health Institute (SHI) and its partners. Participants will gain a comprehensive understanding of the economic benefits linked to SHMS adoption, with a focus on opportunities to reduce production costs and increase net farm income. Drawing on interviews and partial budget analysis from over 160 U.S. farms, we will illustrate how SHMS can effectively mitigate operational risks across diverse climates and production systems. This 15-minute presentation will equip farmers, conservation professionals, researchers, and policymakers with unique insights and practical considerations to support the adoption and implementation of SHMS.

Agronomic and Economic Implications of Cover Crop and Phosphorus Fertilizer BMPs for Water Quality Improvement

Authors: *Kraig Roozeboom (Kansas State University)*; Nathan Nelson (Kansas State University); Elizabeth Yeager (Kansas State University); Sarah Frye (Kansas State University); Gerard Kluitenberg (Kansas State University); Peter Tomlinson (Kansas State University); Elliot Carver (USDA)*

Phosphorus (P) fertilizer management and winter cover crops are promoted to protect water quality, yet they both can also influence crop yield and profits. This study examined effects of three P fertilizer management practices (no P, fall-broadcast P, and spring-injected P) and a winter annual cover crop (with or without) on yields, net returns, and water quality in a no-till corn–soybean rotation. Treatments were replicated three times in a randomized complete block design. Edge-of-field surface runoff was continuously monitored for sediment, total P, and dissolved reactive P (DRP) losses over four years. Production budgets were developed for each treatment and coupled with water quality data to quantify opportunity costs of improving water quality. Applying P fertilizers increased crop yield regardless of application method or cover crop, but the response was more pronounced in corn than soybean. The cover crop reduced corn grain yield in one year but did

not impact grain yield in the other corn year or either year of soybean. The most profitable treatment was fall broadcast P fertilizer with no cover crop, which also had the greatest total P and DRP losses and near greatest sediment loss. Costs of improving water quality were $21.57 to $109.51 per lb total P reduction, $25.61 to $141.68 per lb DRP reduction, and $0.07 to $0.11 per lb sediment reduction per acre depending on the combination of fertilizer management and cover crop practices. Fertilizer management provided the least-cost reductions in P losses, and cover crop provided the least-cost reduction in sediment losses. This paper presents work published in Nelson et al. (2023, J. Environ. Qual. 52:113-125).

Evaluating the Heterogeneity of Cover Crop Effects on Yield, Soil Carbon, and Nitrogen Retention: A Comprehensive Meta-Analysis

Authors: *Anup Sharma (Texas State University)**

Cover crops (CCs) are increasingly recognized for enhancing the resilience and productivity of agroecosystems, yet their impact on crop yields is notably variable, influenced by factors such as geographic location, climate, soil type, cover crop species, and agricultural practices. A meta-analysis of 110 studies across the U.S. from 2001 to 2023 has systematically assessed the effects of CCs on crop yields, soil carbon, and nitrogen retention.

Results reveal that legume CCs can boost yields by over 16%, while non-legume broadleaf and mixed-species CCs contribute to increases of 8% and 6%, respectively. Incorporating CC residues into the soil elevates yields by about 15%, outperforming the practice of leaving residues on the surface. Fields with grass or legume CCs experience yield increases of 16% and 18% over fields without CCs. Particularly in soils with coarse to medium texture and high rainfall conditions, legume CCs surpass no-CC controls by 16%, 6%, and 9% respectively. Moreover, CCs enhance soil organic matter by 7% and microbial biomass by 30%, with carbon storage in soil organic content rising by 16% compared to bare-soil controls. Legume cover crops enhance soil nitrogen content by an estimated around 27-35%, showcasing their ability to contribute beneficially to soil fertility and productivity. However, non-legume CCs reduce soil nitrogen by 27% and nitrate leaching by 31%, unlike legume CC plots. Despite these positives, some few studies indicate neutral or negative yield impacts, especially when CCs compete with the main crop for moisture or nutrients, or due to poor management such as inadequate termination before planting the cash crop. Nonetheless, CCs positively affect soil carbon levels by adding biomass, enhancing the soil's carbon storage capacity. Leguminous CCs, like clovers and vetches, increase soil nitrogen through biological fixation, benefiting subsequent crops. In contrast, non-leguminous CCs may temporarily immobilize soil nitrogen during decomposition, potentially reducing nitrogen availability for the next crop, though soil health and nitrogen cycling improvements may mitigate this effect over time.

Use of the 9-Step Planning Process for Conservation Planning

Authors: *Matthew Meyerhoff (USDA/NRCS)**

Successful application of conservation principles and practices on the ground require conservation professionals to work with the owners, operators, and managers of the targeted land to develop a sound conservation plan. Clients may recognize an issue with their natural resources and have a vision for the conservation of their land but not know how to link the two. The path between that recognized issue and the client's vision is what the conservation professional develops in the form of a conservation plan. Use of the NRCS 9-step planning process is an excellent method for developing that path and providing a conservation plan to clients for achieving their desired conservation outcomes. Implementation of the process results in an individualized plan for the client's fields which is specific to their natural resource goals and provides follow-up assessment to determine the success level of the plan. Use of the process requires a firm understanding of the steps involved and each step's role in assuring a quality product is delivered to the client. The 9-step planning process is discussed with focus on the processes and desired outcomes of each of the steps. Individuals who work with clients to apply conservation principles and practices to the land may find this talk informative and learn about a method and/or concepts that can improve their conservation delivery skills.

Subject: Conservation Models, Tools, and Technologies

Location: Room 203 on Upper Level

Time: 10:30 AM - 12:00 PM

Analyzing the Economic Costs and Benefits of Adopting a Conservation Crop Rotation Alongside Other Conservation Practices Using the Retrospective-Soil Health Economic Calculator (R-SHEC) Tool by American Farmland Trust

Authors: *Robert Ellis (American Farmland Trust)*; Ellen Yeatman (American Farmland Trust)*

In 2024, the American Farmland Trust Water Initiative team re-released the row crop Retrospective-Soil Health Economic Calculator (R-SHEC) Tool – an Excel-based tool released in 2020 for ag conservation professionals to quantify the benefits and costs of soil health practice adoption experienced by already "soil health successful" row crop farmers with exciting improvements to the economic analysis. The soil health practices that can be analyzed in the R-SHEC Tool include no-till, reduced tillage, cover crops, nutrient management, and conservation crop rotation. AFT uses the R-SHEC Tool to develop the partial budget analysis tables featured in their 2-page soil health economic case studies. This re-release is different from past years as it now estimates a farmer's change in net income with a conservation crop rotation alongside other soil health practices using the farmer's field operations instead of using national average estimates of crop per acre net income. Anyone interested in the farm-level economics of adopting a conservation crop rotation should attend this presentation. Using the associated R-SHEC Questionnaire, the farmer provides a summary of their field operations with the addition of a new crop so the Tool can estimate a study area-specific change in net income alongside adoption of other soil health practices. This change requires the collection of additional information, compared to the previous R-SHEC version, from the farmer such as seed cost, chemical and fertilizer application, harvest machinery used, and crop yield for crops impacted by the new crop rotation. Also, the R-SHEC Tool has been re-formatted to reduce risk of double-counting changes in field operations and to make it easier for users to input the farmer's field operations data. Finally, the R-SHEC Tool now gives the user an option to use machinery cost data from other regions, not just the Midwest. With these improvements to the R-SHEC Tool, we have increased the accuracy of the change in net income results by using field-specific data instead of national average datasets and using regionally specific machinery cost data. Building upon the original Tool's 19 case studies, the updated R-SHEC tool is being used to produce at least five additional case studies in 2024. During this presentation, one of these case studies will be used to demonstrate the updated and improved R-SHEC Tool so you too can feature a soil health successful farmer who has diversified their crop rotation for soil health!

Anchors of Coastal Municipal Resilience to a Changing Climate

Authors: *Leslie Gahagan (City of Foley, AL)**

With a changing climate of more severe weather events, Foley, Alabama has initiated a plan to create a more resilient coastal community. This plan is founded on the anchors of environmental

management, planning, restoration, maintenance and conservation. This presentation will discuss how a municipality has implemented these resilient actions to be better prepared for the climate changes in one of the fastest growing areas of the country. Managing the growth led to the need for more in depth planning on stormwater management to reduce compound flooding. Each planning effort produced management measures including maintenance and restoration to be better prepared for extreme weather events. The presentation will also include a discussion of unique land management techniques incorporated to provide educational opportunities. With over a thousand acres of municipally owned land in conservation, Foley has partnered with multiple agencies and cooperatives in these conservation efforts.

Application of a DRAINMOD-Based Decision-Support Tool for Saturated Buffers

Authors: *Ehsan Ghane (Michigan State University)*; yousef abdalaal (michigan state university); Josue Kpodo (Michigan State University); A. Pouyan Nejadhashemi (Michigan State University); Mohamed Youssef (North Carolina State University)*

Saturated buffers (NRCS standard 604) are designed to reduce nitrate loss from subsurface-drained farms. NRCS engineers use the NRCS Design spreadsheet to design saturated buffers. That design criterion is based on choosing a distribution pipe length that diverts at least 5% of the drainage capacity into the saturated buffer. However, designing a saturated buffer may not fit into a one-size-fits-all criterion of 5% of capacity. The objective of this study is to develop and test a new saturated buffer decision-support tool for designing and evaluating saturated buffers. The CIG Classic-funded tool has two model components: DRAINMOD and the saturated buffer module. After the user zooms in to the area of interest, they draw a boundary around the field of interest. The tool automatically retrieves site-specific data including the local SSURGO soil, DAYMET weather, and digital elevation model as input to the tool. The user needs to enter drainage system properties, cropping system, buffer location, and cost of the system. Then, the tool identifies the optimum width of the buffer that maximizes nitrate load removal. The tool also provides financial indices to evaluate the profitability of the saturated buffer. These financial indices include payback period and cost per pound of nitrate removed. During the presentation, we will demonstrate the tool's application for a random farm in Iowa. We also evaluated the tool's prediction compared to observed flow and nitrate load from two saturated buffer sites in Iowa. We expect satisfactory tool prediction of flow and nitrate load based on model evaluation statistics. The tool will be used by water professionals to design saturated buffer systems for optimum nitrate removal.

BMP Cost Effectiveness: The Value of Economic Analysis of Selected Watershed Models

Authors: *Shubham Aggarwal (UMN)**

Watershed models provide a simplified yet conceptual representation of various bio-physicochemical processes and the implications of human activities on these processes. A key

modelling objective must include cost-effective management to determine the impact of implementing best management practices (BMPs). Our work provides a systematic and comprehensive review of decades of published research on the

economic aspects of model output. There has been limited research investigating the relationship between watershed hydrology and various economic systems. We examined Agricultural Conservation Planning Framework Financial and Nutrient Reduction Tool (ACPF FiNRT), Prioritize Target and Measure Application (PTMApp) and Hydrologic Simulation

Program – Fortran (HSPF). ACPF FiNRT provides information about costs and estimated nitrate reduction outcomes from ACPF- generated conservation scenarios. PTMApp estimates the potential cost associated with implementing BMPs on a per unit area, length, or volume for each BMP treatment group using the default cost for each treatment group derived from NRCS EQUIP payment schedules. A default cost value (in $/acre/year) for agricultural BMPs based on the 2016 Minnesota NRCS EQIP cost-share docket is applied automatically in the HSPF cost analysis. The cost-effectiveness of these watershed models gives varying BMP planning outputs and provides practitioners with detailed economic information to inform landowners and offer convincing data.

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Location: Room 204 on Upper Level

Time: 10:30 AM - 12:00 PM

Bring Your Conservation Technical Skills to Federal Service

Authors: *Bernadette VM Mills (NRCS)**

Are you a conservationist interested in building a career within the federal government? Many well qualified individuals seeking federal employment become overwhelmed when they learn about the steps involved in the federal hiring process, then seek other options. In this session I will help to simplify the steps of applying for you. I will walk you through creating a USAJOBS account. Then we will discuss technical assistance skills and how to connect them to vacancy qualifications within the resume portion of a USAJOBS account. I will also teach you how to search for available jobs in conservation that match your technical skill set, and how to set up notifications of newly listed positions that fit the criteria for their desired career path. Finally, I will show you how to apply for a vacancy and what to expect afterwards. Whether your skills include conservation planning, applied ecologocal science, or engineering - there is a federal job waiting for you!

Building Bridges: Networking and Community Engagement

Authors: *Nick Walker (Lexington Soil & Water Conservation District)**

Knowing which organizations to reach out to can be a struggle whether you're new to the job or not. Sometimes it's a little easier to start local with the smaller groups to build your presence and confidence. This presentation will cover Conservation Districts, Conservation Employees Associations, NACD, SCACD, NRCS, FFA, Local Forestry Commissions, Master Gardener Volunteers, 4-H and other groups that can help expand your networking opportunities.

The presentation will provide information about each organization such as goals, how to contact the representatives for different regions, and the services they can provide. I'm hoping to be able to get at least get a few SC representatives for those organizations (NACD, NRCS and DNR specifically).

Conservation Outcomes of an Outreach Skills Training Program

Authors: *Aleta Dam (National Wildlife Federation)*; Jessica Espenshade (National Wildlife Federation); Lekha Knuffman (National Wildlife Federation)*

Various factors influence farmers' decision making to adopt conservation agriculture practices. Conservation outreach efforts are an important source of information and assistance to reach new producers who have yet to adopt conservation practices. Successful conservation outreach efforts are crucial to helping producers adapt to the challenges of climate change and increased demand while also protecting the environment. Recognizing this need, National Wildlife Federation (NWF) developed an outreach training program based on an understanding of farmer decision-making and

grounded in social science. NWF's Grow More outreach training is a professional development program that works to help equip conservation professionals with effective communication and messaging strategies to reach new producers. Since 2019, this program has trained more than 800 conservation professionals from multiple agencies, including the Natural Resources Conservation Service, local soil and water conservation districts, and non-governmental organizations from over ten states. This presentation will use evaluation survey data from past participants to provide insights into outreach activities. The evaluation data give insight not only into knowledge and skill gains of participants, but also changes in outreach strategies and impacts on conservation delivery. This presentation will highlight and evaluate the impact of our outreach training program and provide insights into outreach activities used by training participants. We will also provide recommendations on communication and outreach strategies best suited to reach farmers and ranchers with conservation information.

Pioneering Conservation Partnerships with Creative Funding Solutions

Authors: *Rachael A Millage (ISG, Inc.)**

Funding sources are increasingly available for the implementation of soil and water conservation practices. However, these resources are often limited to specific candidates and traditional methods. In recent years, ISG has helped various stakeholders to secure funding for conventional and new conservation tactics. The solution? A creative approach. This presentation will showcase examples and benefits of creative funding and conservation solutions using case studies and lessons learned. Speakers will outline tips for initiating funding and project conversations with stakeholders.

Subject: Healthy Forest Ecosystems

Location: Room 206 on Upper Level

Time: 10:30 AM - 12:00 PM

Assessing Hydrologically Sensitive Areas as a Novel Indicator of Flood Risks Using a Hedonic Pricing Method

Authors: *Wenlong Feng (New Jersey Institute of Technology); Zeyuan Qiu (New Jersey Institute of Technology)**

The FEMA's floodplain maps are pivotal tools for flood risk management and fostering flood resilience in the United States. However, these maps are often inadequate in capturing the full

extent of flood risk, resulting in substantial unexpected flood losses. Climate change further exacerbates the defect in conventional floodplain maps. This study investigates the potential of the Hydrologically Sensitive Areas (HSAs) to improve flood-prone area mapping by examining their impact on home sale prices in Hillsborough Township and Montgomery Township,

Somerset County, New Jersey. The extent of HSAs is extracted from a 10-meter resolution DEM with a soil topographic index. Using a combination of the hedonic pricing method and the

difference-in-difference framework, the research finds that both the 100-year floodplain designation and HSAs significantly and negatively affect single-family home prices. In contrast, the 500-year floodplain designation has no significant influence. Compared to home prices outside HSAs and the 100-year floodplain, homes only inside HSAs suffered a price discount of

2.1%, a price discount of 7% for homes only in the 100-year floodplain, and a price discount of 3.8% for homes inside HSAs and the 100-year floodplain. Our results highlight the capability of

HSAs to identify flood-prone areas beyond conventional floodplain designations flood-prone areas outside the floodplain designation. This research not only contributes to our understanding of the relationship between flood losses, land use, and community flood resilience but also lays the groundwork for future studies in this domain.

Developing Landscape Resilience Indices to Mitigate Floods and Flood Impacts in New Jersey

Authors: *Zeyuan Qiu (New Jersey Institute of Technology)*; Wenlong Feng (New Jersey Institute of Technology)*

Urbanization encroaches natural landscapes and causes severe flood and flood damages. Building a resilient landscape is an ultimate way to mitigate flood hazard and its impacts. We propose a set of indices to measure landscape resilience to flood and flood impacts using various GIScience tools and geospatial data. First, a geospatial layer of hydrologically sensitive areas (HSAs) is derived from a digital elevation model (DEM) and soil data that measures landscape hydrological sensitivity and connectivity following a landscape hydrology concept called "variable source hydrology". Second, a

set of landscape vulnerability indices is developed by overlaying the HSAs with land use to measure how HSAs are intruded by various urban land uses that exacerbate flood and flood impacts. Third, a set of landscape robustness indices is developed by overlaying the HSAs with the areas protected from urban development to measure how the HSAs are preserved through various regulatory and nonregulatory land use controls to ensure a rapid recovery from flood hazards. We apply the framework to New Jersey to measure these indices for each municipality and county in New Jersey and validate those indices by analyzing the spatial correlations between these indices and the flood damages recorded in the Federal Emergency Management Agency's flood insurance claim databases. It is expected that the flood damages are positively correlated with the landscape vulnerability indices and negatively with the landscape robustness indices. The proposed indices will help direct communities' efforts in landscape planning, landscape management and landscape design to enhance landscape resilience.

Impact of Economic, Soil and Environmental Factors on Cover Crop Adoption: A Survey Approach

Authors: *Bonny Amin (Texas State University)**

Cover crops (CC) can enhance soil health, economic, and environmental sustainability; however, the adoption rate is 3~5% across the USA, because cover crop adoption is dependent on a "complex web" of internal and external economic, soil, and environmental factors. Existing literature on CC adoption finds that farmers are more willing to adopt cover crops as a conservation practice. However, diversity in the farming system, cropping patterns, and the lack of access to financial subsidies make CC adoption challenging for farmers. The research focuses on the cover crop adoption (dependent variable) to be determined by economic factors (annual sales, payment assistance), soil properties (soil moisture, soil structure), and environmental factors (reducing fertilizer, pesticide, and herbicide use). An online survey questionnaire was distributed to farmers with convenience sampling, including closed and open-ended questions. The regression model assessed cover crop adoption in addition to descriptive statistics, considering soil, environmental, and economic factors. In addition, data on farmers' demographics, the benefits and challenges of adopting cover crops, and their perspectives on farm resilience to adopt cover crops was analyzed through quantitative data analysis. It was found from the pilot study (n = 30) that payment assistance will encourage farmers to use cover crops. The regression results showed that the adoption of cover crops is significantly negatively impacted by the absence of soil moisture and farm size. In contrast, farmers with high annual gross sales are likely to adopt cover crops. From the research findings, policymakers will be able to design site-specific management practices considering farm heterogeneity and the diverse perspectives of farmers to encourage cover crop adoption across the United States. Therefore, the government can promote sustainable farming, provide farmers' friendly programs, and adjust policy for conservation initiatives.

Subject: Water Resource Assessment and Management

Location: Room 208 on Upper Level

Time: 10:30 AM - 12:00 PM

A Review of the Sandusky Bay Initiative

Authors: *Michelle C Pressel (The Nature Conservancy)*; Katelyn Beckemeyer (The Nature Conservancy)*

The Sandusky Bay Initiative (SBI) is an ambitious multi-agency effort launched in 2016 which developed a portfolio of projects designed to enhance the quality of life and sustain the economic benefits from a clean Sandusky Bay, which has been transformed from a thriving matrix of wetlands to a highly turbid algal-dominated, open water system. Through extensive research and modeling 12 tier-1 projects were designed that focus on 1) reducing sediment resuspension through shoreline and wave energy reduction 2) enhancing nutrient assimilation and processing and 3) creating wetlands, SAV and emergent wetland habitats for fish and wildlife. As of January 2024, 1 project has been completed and 3 more are funded and in various stages of completion.

The presentation will consist of three main parts:

1.Sandusky Bay Context/Background: The presentation will begin with providing important context for the area. This involves providing a higher-level overview of Lake Erie that focuses on its importance to the local community and a more detailed focus on Sandusky Bay. The detailed focus on Sandusky Bay will highlight its historic characteristics which demonstrate its ecological and anthropogenic importance and describe the current issues and causes of the issues that Sandusky Bay currently faces.

2.Summary of the SBI: This portion of the presentation will provide a summary of the SBI's history starting from its inception in 2016. It will begin by discussing the multi-disciplinary nature of the group and the extensive work done in the planning stage to identify stressors in the system. Next, it will identify the goals of the SBI that were established based on data from the planning stage. Finally, it will conclude with a high-level summary of the 12 tier-one projects that were developed based on further data and modeling done to achieve on the goals of the SBI.

3.Project Update: The final portion of the presentation will review the current SBI projects (4) that have been completed (1 of 4) and are currently underway/funded (3 of 4). This will include the first completed SBI project, Pickerel Creek Riparian, which reconnected a channelized creek to its floodplain and wetlands. It will also include the second SBI project to be funded that is currently underway, Raccoon Creek, and the most recently funded projects that are underway Pickerel Creek East and Pickerel Creek West Island #4. These three of which focus on constructing a living barrier island offshore and parallel to Pickerel Creek Wildlife Area. TNC will discuss the design and expected outcomes of these projects from an ecological perspective and discuss the logistics of the project from a project management perspective.

Companion Canine Nutrient Contributions to Peri-Urban Environments

Authors: *Brad Lee (University of Kentucky)*; Dwayne Edwards (Virginia Tech); Rick Durham (University of Kentucky)*

As dogs become more popular and human populations concentrate in urbanized areas, management of canine feces will become more important. At present, only about 60% of dog feces is collected from public spaces and disposed in a landfill. Nutrient contributions to stormwater attributable to dogs are not known to the regulated Municipal Separate Storm Sewer System communities (MS4s), the local regulatory entities that will make dog feces cleanup a priority in future years. Quantification of nutrients from dog feces is particularly important to a state like Kentucky, which ranks 3rd in the nation in canines per household (1.9 dogs in 45.9% of households). To quantify nitrogen and phosphorus from canine feces, individually packaged feces were collected from 1005 canines that deposited at 12 apartment complexes and 11 dog parks in 3 of the most urbanized areas of Kentucky. Moisture content averaged 69.2% (s.d. = 5.5%, range: 31.3% - 91.1%, n = 746), nitrogen (N) averaged 3.9% (s.d. = 0.8%, range: 0.9% - 6.5%, n = 1005) and phosphorus (P) content averaged 3.0% (s.d. = 1.0%, range: 0.4% - 8.0%, n = 1005). The Environmental Protection Agency estimates that the average dog produces 125 kg of feces annually. Using this value, the canine population of Kentucky adds 2245 Mg N and 1729 Mg P to the environment each year. At the home lawn scale, the average companion canine adds 1.2 kg of P and 1.5 kg of N annually. Using the University of Kentucky recommended annual application rate of 0.9 kg N per 93 m2 lawn, one average dog would apply enough N to cover a 155 m2 lawn and 2-fold the amount of P applied at the N-equivalent rate of a 10-10-10 fertilizer. Nutrient runoff from canine feces on turfgrass grown in a 1 m x 1 m x 0.15 m box with a rainfall simulator will be discussed. Results to date suggest that dog excrement is a significant source of nutrients in the urban environment and should be taken into consideration when developing MS4 nutrient management strategies.

Onion Response to Seeding and Irrigation Depths and Wheat Straw Mulching

Authors: *Udayakumar Sekaran (Oregon State University)*; Anuoluwa Sangotayo (Oregon State University); Erik Feibert (Oregon State University)*

Heat stress in the absence of adequate soil moisture conditions can be an important limiting factor to crop growth and development. Using straw mulch can help to keep exposed, dry soil cool, which is essential for crops like onions. Mulching also helps retain soil moisture, improve nutrient, and water retention, and encourage favorable soil microbial activity. This work aims to identify the most effective combination of seeding depth, drip irrigation depth, and mulching techniques to reduce the impact of heat stress on onions, especially during June and July and thereby increase marketable yield in Oregon. Further, fine-tuning irrigation and seeding depth could be useful in managing limited water supplies, reducing crop stress, and increasing crop profitability. The results revealed that in June month, 3-inch drip tape depth reduced the soil temperature compared to 5-inch drip tape depth, but this difference faded on the subsequent months of July and August.

Mulching treatments showed no significant impact on soil temperature in June and July; however, in August, the non-tape row mulching treatment led to increase in soil temperature compared to the no mulching. An interesting interaction effect was observed in June, where the combination of a 3-inch drip tape depth with tape row mulching resulted in significantly lower soil temperature compared to the 5-inch depth with no mulching. The study also showed that drip depth doesn't significantly affect the onion yield, but tape row mulch increased super colossal grade. Seeding depth at 0.5 inches is key for achieving significantly higher yield of medium, jumbo, and colossal grades. Regarding soil health, a 3-inch drip depth increases soil respiration and microbial activity. Non-tape row mulch is beneficial, enhancing soil nutrients, and the overall soil health score. Strategic seeding depth also positively impacts soil respiration and microbial activity. In conclusion, planting onions at a shallow depth of 0.5-inch, using drip tape at 3-inches, and applying straw mulch work together to regulate soil temperature, ensure proper irrigation, and promote soil health, ultimately enhancing onion yield.

Spreading the Word About Kentucky's Agriculture Water Quality Program

Authors: *Paulette Akers (Kentucky Division of Water)**

Kentucky's Agriculture Water Quality Act requires farmers with 10 acres or more to develop a plan for protecting water quality. Although the Act was passed in 1994, few farmers kept their plans up to date. While some farmers are well connected to their local conservation district office or their extension service, a large number may be unaware of state regulations because they are not as engaged locally. For more than 25 years, the Kentucky Division of Water had relied on soil and water conservation districts or extension agents to spread the word about these requirements in their interactions with farmers. The planning tool underwent a major revision in 2021, shifting from a fillable pdf to an online tool. Kentucky Division of Water and Kentucky Division of Conservation worked together with the University of Kentucky and other members of the Agriculture Water Quality Authority to develop ways to advertise the new tool. The two phases included outreach to local organizations who work with farmers and may be asked to assist in development of plans, and a second phase of broad outreach to the farming community as a whole. Trainings were conducted in person and virtually for agriculture professionals. A series of fact sheets and a new website were developed for the farming community. Various mass market media tools were used with varying success, including radio, website banners, local newspaper, commodity publications, conference booths and print media. The lessons learned have helped target how we continue to conduct outreach.

Subject: Conservation Models, Tools, and Technologies

Location: Room 202 on Upper Level

Time: 1:30 PM - 3:00 PM

CRP Menu: A Spatially-Explicit Decision Support Tool to Enhance Landowner Engagement in CRP Incentives Programs

Authors: *Kristine O. Evans (Mississippi State University)*; Mark McConnell (Mississippi State University); Brad Thornton (Mississippi State University); Yong Liang (Mississippi State University); Reshma Devi Mandli (Mississippi State University); Daniel Egerson (Mississippi State University); Rishita Garg (Mississippi State University); Satish Samiappan (Mississippi State University); Amanda Sesser (U.S. Fish and Wildlife Service); Shannon Westlake (U.S. Fish and Wildlife Service)*

Understanding eligibility for practices under Farm Bill programs like the Conservation Reserve Program (CRP) can be complex and landowners are often overwhelmed by or limited in access to information about practices appropriate to their objectives. A well-designed, public-facing decision support system can help reduce information barriers that constrain CRP enrollment. Under a stakeholder co-production framework, we worked closely with landowners and agency staff in 2023 and 2024 through a series of 12 workshops in three pilot states (Illinois, Mississippi, Missouri) to develop the new web-based CRP Menu Tool. The CRP Menu Tool allows landowners to explore available CRP conservation practices in their counties of interest, match practices to conservation objectives, and check potential field eligibility, average soil rental rates, and other field-level features that inform landowner enrollment or reenrollment decisions. The tool produces custom reports that can enhance engagement with agency staff to break down barriers to enrollment decisions and increase efficiencies in the enrollment process. Feedback from landowners and agency staff was directly incorporated into each phase of pilot tool development, which is designed to be regionally and nationally scalable. We showcase the initial phase of CRP Menu Tool development and seek additional feedback from stakeholders within and outside the pilot states as we look toward expansion in subsequent phases.

Land Cover Dynamics in Barbados: Implications for Soil Conservation

Authors: David O Yawson (The University of the West Indies)*

The composition of land cover types and their spatio-temporal changes have important implications for soil conservation. For example, the type, structure, and rate of change of vegetative land cover significantly influences soil erosion and landslides. In Barbados, soil conservation efforts are formally concentrated in the Scotland District (40 sq.km or 15% of Barbados), which is vulnerable to landslides and soil erosion due to its sedimentary geology. The rest of Barbados is underlain by reef limestone rocks. This study applied change detection techniques to satellite imagery to map and assess the intensities of change in key land cover types in Barbados and to assess the implications for soil conservation, especially in the Scotland District. The results showed that woody vegetation cover is concentrated in the Scotland District but

declining at a faster rate recently. Especially, systematic gains and losses between woody vegetation and other vegetation (represented mainly by agriculture) were observed. The rapid loss of woody vegetation in Barbados, in general, and the Scotland District, in particular, suggests a potential risk of soil loss through erosion and landslides. The results suggest that tree planting as part of soil conservation efforts, especially in the Scotland District, might not be keeping pace with loss of woody vegetation. It is concluded that the highly dynamic land cover, especially the woody vegetation in the Scotland District, requires urgent attention to support soil conservation and land stabilization goals. Tree planting efforts need to be intensified while direct soil or slope stabilization should be strengthened. Soil conservation policy should be strengthened with regulatory instruments that limit direct removal of woody vegetation in the Scotland District. Multistakeholder processes should be enhanced to gain wider support for soil conservation efforts across the Island.

Plug and Chug Outcomes Calculator to Estimate Water Quality and Climate Benefits

Authors: *Jean Brokish (American Farmland Trust)**

We've all been there – having finally convinced a couple farmers to adopt practices with project funds, the struggle becomes translating those acres into environmental outcomes when it comes time for the quarterly report. Using water quality data available from the Illinois Nutrient Loss Reduction Strategy, American Farmland Trust created a back-of-the envelope calculator to estimate nitrogen and phosphorus load reductions for cover crops and no-till. The ability to estimate sediment and greenhouse gas reductions was added through the integration of additional data, and in the summer of 2023 the team enhanced functionality to create an excel-based "Plug & Chug Outcomes Calculator" (PCOC) that estimates project-level outcomes.

This session will highlight how PCOC was built, and how others can replicate the PCOC for use in their states using local data. We will demonstrate how it is currently being used in Illinois to track outcomes, and new ways that we're applying PCOC data to inform policy and funding decisions.

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Location: Room 204 on Upper Level

Time: 1:30 PM - 3:00 PM

Creative Conservation: Advancing Through Innovation, Collaboration, and Stewardship

Authors: *Kaitie Hartmann (Great Outdoors Foundation)**

Meaningful action requires unconventional strategy, unlikely partnerships, and uncompromising integrity. A leader in conservation at what some consider ground zero for environmental priorities — the state of Iowa — the Great Outdoors Foundation (GOF) has tapped into its values of innovation, collaboration, and stewardship to advance unprecedented change for water quality in particular and the environment at large. GOF and its partners share a case study of how this model of conservation has identified new ways of addressing Iowa's water quality while taking a non-threatening posture toward the agriculture sector, Iowa's main economic and political driver.

After recognizing the potential opportunity in value-driven private capital, GOF began collaborating with its partners to identify key funding gaps that, if addressed, could enable significant progress for water quality infrastructure. This led to the creation of the Conservation Fund, a dynamic funding mechanism that matches value-driven investors with water quality improvement initiatives. Using a proprietary capital stacking model, Conservation Fund dollars typically unlock tenfold funding through partner, state, and federal sourcing.

Additionally, GOF has contracted Antea Group, a third party environmental, health, safety, and sustainability consultant, to create a real-time dashboard with performance metrics for investors. These include, but are not limited to:

• Replenishment volume

• Average nutrient reduction

• Acres drained

• Sediment reduction

Ultimately, we see this collaborative, cross-sector approach as the path forward to addressing water quality in Iowa, and beyond. The Creative Conservation model allows technical field experts to manage projects in bulk, creating efficiencies and removing barriers to adoption, while simultaneously addressing one of the most complex issues in infrastructure development — funding.

Developing a Webinar Series to Help Project Managers Add Outcomes Estimation to Their Conservation Toolbox

Authors: *Aysha K Tapp Ross (American Farmland Trust)*; Michelle Perez (American Farmland Trust)*

In November 2020 American Farmland Trust released "A Guide to Water Quality, Climate, Social, and Economic Outcomes Estimation Tools: Quantifying Outcomes to Accelerate Farm Conservation Practice Adoption." The Outcomes Estimation Tools (OET) Guide recognized that managers may want to add other tools to the proverbial "conservation toolbox" beyond the existing financial, technical, and educational assistance most conservation professionals deploy. While creating the guide we discovered there were potentially over 1,000 projects funded by EPA and USDA NRCS grant programs with outcomes estimation needs, and managers who may require guidance in deciding which tools to use and how to use them. To fulfill these needs, a webinar series was developed featuring 13 of the tools and methods featured in the OET guide, plus three recently identified tools.

The webinar series launched May 2023 with an introduction to the OET guide and will conclude September 2024. Several metrics have been recorded to track our progress in training ag project managers, including a needs assessment survey prior to the series, attendance, demographic polls, exit surveys after each webinar, YouTube views of the recordings, and analysis of tools recorded by project managers in the EPA Grants Reporting and Tracking System (GRTS) before and after the series. Through these metrics, we will demonstrate how the webinar series has influenced the usage of outcome estimation tools by agricultural project managers. In the future, these analyses will be used to request funding to a) update the OET guide, b) expand and improve the featured tools so they cover more conservation practices, production systems, and geographical areas, and c) launch a 50-state data and mapping tools training webinar series to teach climate-smart ag project managers where the priority water quality, water quantity, and habitat areas are in each state to achieve multiple co-benefits.

Elevating Engagement: Empowering Soil Health Knowledge Transfer Through Outreach and Training

Authors: *Emily Bruner (Soil Health Institute)*; Erin Gundy (Soil Health Institute); Ann Marie Calabro (Soil Health Institute)*

The Soil Health Institute is strategically implementing a comprehensive plan to scale up the adoption of regenerative soil health management systems that provide numerous on-farm and environmental benefits. We currently offer programming across 35 U.S. States and 3 Canadian Provinces, actively providing farmers and advisors with the knowledge and tools they need for successful implementation of soil health systems.

During this 15-minute presentation, we will: 1) provide an overview of our education initiatives across diverse soils, climates, and cropping systems; 2) explore our approach to designing curriculum and resources to address challenges and foster inclusivity; and 3) share insights on how we leverage technology, partnerships, and community engagement to extend the reach and impact of our outreach efforts. Attendees will gain a unique understanding of how our commitment to continuous improvement allows our growing team of Soil Health Educators to ensure our programs remain responsive and relevant by intentionally integrating input from listening sessions and

pre/post-event surveys. Farmers, conservation professionals, and researchers are encouraged to attend and learn more about our successes, lessons learned, and our path forward toward collaboration and lasting impact.

Illinois Farmers “Find” Conservation Funding with the Financial Incentives Database (FIND) Tool

Authors: *Helen VanBeck (American Farmland Trust)**

In 2024, there has been an unprecedented number of incentive programs offering farmers financial payments to adopt practices which improve water quality, build soil health, and limit greenhouse gas emissions.

From the local county’s cover crop incentive to a growing list of carbon market programs; from the tried-and-true Farm Bill programs to the new-and-shiny Climate Smart Commodity opportunities. For this historic, once-in-a-lifetime investment in conservation to successfully achieve our environmental goals, farmers must be able to easily and efficiently "find" the funding program that will work best on their farm!

How can farmers find out which program is right for them? Where can they compare multiple programs side-by-side? Which programs are available to them if they have already adopted conservation practices?

To address these questions for farmers in Illinois, the Illinois Sustainable Ag Partnership (ISAP) developed the Financial INcentives Database, or FIND Tool, an online, filterable database listing information for over 60 incentive programs available to farmers in the state. The online tool helps farmers sort and filter through these programs to "find" the funding program that works best for them based on their location, existing operation, and interest in additional conservation practices.

This session will explore ISAP’s process for developing the FIND Tool, share suggestions for others who may be interested in replicating the tool in their state, and feature a live demo of the tool in action.

Subject: Social Sciences Informing Conservation

Location: Room 206 on Upper Level

Time: 1:30 PM - 3:00 PM

Agricultural Financial Instruments' Roles in Land Practices and Soil and Water Conservation in the Upper Midwest

Authors: *Yu Lu (University of Wisconsin-Madison)*; Adena Rissman (University of Wisconsin - Madison)*

Farmers' land practices have profound impacts on soil health and water quality. Agricultural financial instruments, such as crop insurance, agricultural loans, and conservation cost-share programs, are important in enabling farmers to adapt to climate change and market risks while influencing land management practices and farm soil and water conservation. However, the relationships between multiple financial instruments and land practices remain unclear. These financial instruments can steer farmers toward more conservation practices or, conversely, toward farm intensification practices. Existing research primarily focuses on crop insurance, with less attention on agricultural loans, conservation cost-share programs, and the synergies among these instruments. This study aims to explore how crop insurance, agricultural loans, and conservation cost-share programs are associated with land practice adoption. We conducted a farmer survey across eight states in the Upper Midwest. Our results indicate that crop insurance, agricultural loans, and conservation cost-share programs have complex associations with conservation practices. The negative association between conservation practice adoption and financial instruments could be mitigated by conservationist and civic-minded identities. Conservationist indicates that farmers value environmental outcomes, while civic-minded identity means they view themselves as community leaders. This research contributes to the broader understanding of financial instruments in sustainable agricultural development and highlights the need for financial policy adjustments to enhance conservation practice adoption.

Motivating Collective Action to Solve Collective Water Quality Problems

Authors: *Robyn Wilson (Ohio State)*; C. Dale Shaffer-Morrison (University of Essex)*

Typical conservation programs rely on individual-level farmer behaviors, often using incentives to motivate conservation practice adoption at the field or operational level. But despite these payment programs, enrollment in many conservation practices remains low, and much lower than the target rates needed to address water quality challenges. In addition, greater participation in structural water management practices is likely needed to address rainfall inundation challenges in regions where spring rainfall contributes to both on-farm challenges as well as downstream impacts. Rather than focusing on the adoption of individual-level in-field practices, this study focuses on understanding what makes a cooperative, large-scale community conservation practice appealing to operating landowners. Using a choice experiment with farmers across the western Lake Erie basin, we propose a large, interconnected water catchment system that could be installed

throughout a small watershed to better manage water extremes. Such a system would use existing drainage networks, adding additional conservation drainage practices where needed along with the inclusion of holding ponds or reservoirs to create a closed-loop drainage system that also allows for irrigation in the summer. We assess how preferences for this community-level catchment system are impacted by dynamic social norms (i.e., the extent to which more and more, or less and less local landowners are participating), as well as tradeoffs between personal costs and benefits (i.e., the potential yield bump received relative to the land contributions). We also assess demographics, socio-psychological farmer characteristics, and farm operation characteristics to determine if specific classes or types of farmers have homogeneous preferences for such a catchment system and reported willingness to participate. The results help identify how such a program could be designed to maximize landowner participation, and we will use the spatially explicit results to model how such programs could help achieve downstream water quality goals.

Participatory Approaches to Conservation Policy Development

Authors: *Adam P Reimer (National Wildlife Federation)*; Julie Doll (Michigan Agriculture Advancement)*

Efforts to support producer and landowner agricultural conservation most typically focus on federal policy, especially long-running Farm Bill conservation programs. States have increasingly become active in agricultural conservation policy, including in the areas of soil health and climate-smart agriculture. Government policy development often follows a top-down process, including dynamic interactions between policymakers, government agencies, advocacy groups, and producer-representing organizations. This talk will highlight a participatory project that takes a different approach to state-level conservation policymaking, one grounded in the experiences of producers. Through a series of listening sessions with producers, conservation professionals, and farm advisors in Michigan, this project seeks to generate ideas to improve existing state-level programs, define soil health and conservation outcomes, and identify opportunities for new policies that would support transitions to regenerative agriculture. In this session, we will share insights from these listening sessions, as well as provide recommendations for participatory policymaking efforts.

The Effects of Collective Trauma on Farmer Conservation Behavior

Authors: *Chris Morris (Iowa State University)*; J. G Arbuckle (Iowa State University)*

Collective trauma refers to psychological effects that are experienced by a group of people in response to shared traumatic conditions. Farmers represent a unique population that is chronically exposed to potentially traumatic events and conditions particular to the agricultural industry. Farming communities in Iowa have experienced significant drought, the farm crisis of the 1980s, declining rural communities, high levels of debt, and financial stress caused by boom-and-bust markets and increasing dependence on inputs such as fertilizer and pesticides. These potentially traumatic experiences can have long-lasting effects on farmer well-being as well as on-farm

decision making. This study examines the effects of collective trauma on farmer decisions and potential subsequent effects on sustainability outcomes. It utilized quantitative data from the Iowa Farm and Rural Life Poll (IFRLP) survey, an annual survey of Iowa farmers. The survey asked farmers about their experiences with potentially traumatic farming experiences, as well as the presence of common symptoms of trauma and any coping mechanisms they may have employed. Analysis examined relationships between potentially traumatic experiences and conservation adoption. The study also conducted in-depth semi-structured interviews with farmers and farmer-oriented behavioral health experts to qualitatively investigate how collective trauma affects individual farmers, their families, and their farming communities, and in particular how it might impact farm management decisions and sustainability outcomes. Results from the analysis of both survey and interview data will be presented, focusing on the relationships between collective trauma and conservation adoption behavior. Possible implications of these results regarding how to potentially improve conservation policy and technical assistance to increase conservation adoption will also be discussed.

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

Location: Room 208 on Upper Level

Time: 1:30 PM - 3:00 PM

Bringing Soil Health Assessment to Farmers in Ontario's Golden Horseshoe

Authors: *Ryan E.D Carlow (Greenbelt Foundation)**

Soil health assessment is new to farmers in Ontario, Canada, and is critical for increasing the adoption of beneficial management practices (BMPs). These assessments offer farmers quantitative data that substantiates their anecdotal observations of soil conditions over the years. The Greenbelt Foundation and Soil Health Institute have partnered to offer soil health testing to grain and oilseed farmers in Ontario's Golden Horseshoe region. Guided by the principle that you can't manage what you can't measure, this program provides Ontario farmers with detailed information on their soil health using both the Ontario Ministry of Agriculture, Food and Rural Affairs' Soil Health Assessment and Plan and the Soil Health Institute's minimum suite of indicators. Launched in 2023, the soil health testing program spans four years to provide producers with soil health testing and education on conservation practices informed by locally relevant data. Using a variety of outreach strategies, over 100 farmers currently using different management systems and on various points in their soil health journey, were enrolled in the research program in the first two years. Participants receive a detailed soil health report, as well as information on how conservation practices influence soil health and what cost-share programs are available to help them implement new practices. To date, 61 participants from year one have received their soil health results and will be surveyed to determine the changes they plan to make on their farms based on these results. Many program participants described a lack of baseline soil health data as a barrier to implementing new practices and a reason for their participation. Increasing the number of farms using BMPs in this region can improve climate resilience, sequester more carbon, and increase profitability. To further build on this work, more information about how soil health tests influence farmers in terms of BMP adoption will be explored.

Exploring Linkages Between Soil Health and Human Health: A New Report by the National Academies of Sciences, Engineering, and Medicine

Authors: *Kara Laney (National Academy of Sciences)**

The biological, chemical, and physical health of soil is integral to the balanced and optimized health of people, other animals, and ecosystems, yet its value is underappreciated and understudied. In 2023, an interdisciplinary committee was convened by the National Academies of Sciences, Engineering, and Medicine to bring attention to the value of soil health to human health and to examine the evidence for linkages between the two. The committee's new report identifies research gaps in the study of microbial communities across species and environments and explores how better microbiome data collection, storage, and sharing could pave the way for microbial amendments that improve soil health and human health. The report also recommends data

gathering and research to increase our understanding of the mechanisms underlying ecosystem services and functions and discover methods for enhancing these services. Opportunities for adapting agricultural systems to minimize tradeoffs between food production and ecosystem health are also explored, as is the interaction of the soil microbiome and contaminants, including microplastics and PFAS. Implementing the recommendations of the report would decrease the external costs and the adverse effects on human health often associated with agricultural management practices, improve soil health, support the sustainability of food produced by U.S. agriculture, and advance our knowledge of the microbiome across soil, plants, and humans.

On-Farm Soil Health Assessments in Central Kansas

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

Assessing soil health parameters under various management practices can help to understand which practices are likely improving soil productivity and function, and which are degrading it. 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. Soil health measurements include aggregate stability, soil organic C, bulk density, soil respiration, enzymes, and permanganate oxidizable C. The objectives are to evaluate any correlations between management practices and soil properties to a depth of 1 m, especially within the top three depths of each pedon. The major categories of management are perennial/native vegetation, no-till, and tillage intensive systems, and comparisons were also made between crop rotations. The systems with the least disturbance and the most varied plant species throughout the 12 year period showed more stable aggregates, lower bulk density, higher soil organic C consistently over intensively tilled fields, particularly in the surface 5 cm and the 5 to 10 cm depths.

Soil Health Responses to Cropland Management in Ohio

Author: *William Osterholz (USDA ARS)**

Generating healthy soil is a primary goal of several cropland management practices, such as reduced tillage, manure application, diverse crop rotation, and cover crops. However, the effectiveness of these practices for enhancing soil health 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, bulk density, active C, and soil protein. Results will reveal the specific effects of management practices on the soil health indicators. Insights from this work will include estimating the relative effectiveness of management practices for improving soil health in Ohio, in turn helping farmers prioritize management practices that are most likely to improve soil health.

Subject: Adaptive Management of Conservation Efforts

Location: Room 202 on Upper Level

Time: 3:30 PM - 5:00 PM

A Framework to Quantify Realistic and Achievable Regenerative Agriculture Goals to Support Fishable, Swimmable, and Drinkable Water Resources

Authors: *Haleigh Summers (Sand County Foundation)*; Heidi M Peterson (Sand County Foundation); Jim Eckberg (General Mills, Inc.); Margot Conover (General Mills, Inc.)*

Sand County Foundation and General Mills, Inc. launched a pilot study to quantify the potential water quality benefits attainable through practical and achievable regenerative agriculture implementation goals. We targeted the Lake Michigan Basin, an important dairy, grain, and oilseed sourcing region that supports a diverse range of ecosystems and endangered species. The objective was to build out a framework, implementing a widely accessible tool that could be applied by local conservation staff to set realistic, watershed-level, clean water targets. The U.S. Environmental Protection Agency's (EPA's) Pollutant Load Estimation Tool (PLET) was selected to quantify phosphorus and sediment reduction from six conservation scenarios in each HUC-8 watershed. PLET is free and provides a user-friendly web interface to create a customized watershed model capable of evaluating loading and load reductions at multiple scales. These conservation scenarios included rotational grazing of pastures, cover crops, conservation tillage, nutrient management, prairie strips, and a "regenerative agriculture" scenario incorporating all five practices. Each scenario was compared to a baseline of the current adoption rate of cover crops and conservation tillage established using data provided by Regrow. Using Environmental Quality Incentives Program payment rates, we quantified the needed investment to reach the scenarios for each watershed and also estimated the total number of farms to engage. The model estimated that the regenerative agriculture scenario could reduce phosphorus loads by 21% and sediment loads by 10% compared to the current estimated loading. This regenerative agriculture scenario would require an additional 652 thousand acres of conservation practices and $260 million in investment based on federal rates. In summary, results confirm that current conservation investments by multiple stakeholders at the federal, state, and local levels can result in meaningful impact to support fishable, swimmable, and drinkable water resources. This framework is scalable to regions outside of the Lake Michigan Basin.

Roadmap to Water Resilience: Cascading Effects of Improved Water Management

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

In South Dakota, and many states with a high agricultural production, too much or not enough water is often the limiting factor for crop production. Soil can play a significant role to increase the potential for managing excess or deficit water. In turn, agricultural management can affect some soil characteristics over time and potentially make these soils more resilient to large fluctuations in soil moisture. The cumulative impact of improved water management in individual fields could be

significant at a watershed scale. A watershed-scale study was implemented to evaluate the impact of soil health practices on runoff at the field and watershed scales. Soil moisture was measured for three seasons in 23 fields across the Willow Creek watershed, northwest of Sioux Falls, SD. Estimations of runoff and corresponding curve number (value that quantifies likely runoff from a landscape) was estimated for all fields for all rainfall events during that time period. No-till had significantly lower curve number than conventional tillage practices. These updated curve numbers were then applied to a watershed model to estimate the potential reduction in peak flow and total flow volume. Finally, results from a survey send to farmers in the watershed was used to determine the likely potential implementation. Realistically, peak flow reductions were relatively modest at around 5%. However, if updated recruiting efforts or additional incentives could lead to adoption of no-till in other parts of the watershed, then peak flow reductions could be upwards of 20%. This project incorporates physical field measurements, watershed modeling, and socio-economic surveys to determine a roadmap to water resilience at the field and watershed scales. It is intended that this approach can be used in additional watersheds in South Dakota or across the Midwest.

The Value of Citizen Scientists

Authors: *Bernadette VM Mills (NRCS)**

Correcting the degradation on the Earth is a big job. Getting conservation on the ground takes a lot of labor. The more boots we get on the ground, the more we can accomplish. Many everyday citizens can contribute to science in simple ways. In one example, a cargo ship spilled 29,000 bath toys into the Northern Pacific Ocean in 1992. Recognized by the maker's mark, people have been calling in and reporting finding them washed up across the shores of the world. Scientists have learned a significant amount about the ocean's current by plotting when and where the ducks have turned up over the last thirty years. This incident was a fortuitous accident, but there are many ways ordinary people can contribute to science. In this presentation I will share how data can be collected by anyone and shared to further scientific knowledge.

Water Regime and Slow-Release Fertilizer Effects on Greenhouse Gas Emissions from Rice in Greenhouse and Field Settings

Authors: *Diego Della Lunga (University of Arkansas)*; Kristofor Brye (University of Arkansas)*

Furrow-irrigation is an alternative water regime that has been increasingly adopted in Arkansas, and the mid-southern United States in general. Dynamic environmental conditions under furrow-irrigated systems can enhance the frequency of wet-and-dry cycles that can potentially exacerbate greenhouse gas [GHG; i.e., carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O)] production and release. Among the management of nutrients in furrow-irrigated systems, phosphorus (P) represents a substantial challenge. The environmental sustainability of rice (Oryza sativa) production systems needs to be evaluated across different water regimes and fertilizer-P sources. Therefore, the objectives of this study were to: i) evaluate the effects of water regime (i.e., flooded and furrow-irrigated conditions) and fertilizer-P source [i.e., diammonium phosphate (DAP), chemically precipitated struvite (CPST), electrochemically precipitated struvite (ECST), triple

superphosphate (TSP), and an unamended control (UC)] on season-long CO2, CH4, and N2O emissions and global warming potential (GWP) in the greenhouse and ii) evaluate the effects of ECST, CPST, TSP, DAP, environmentally smart nitrogen (ESN), and UC on GHG emissions, GWP, and plant and soil responses at the up-slope position of a furrow-irrigated rice field in east-central Arkansas. Gas samples were collected weekly in each growing season between planting and harvest using the enclosed-headspace, static-chamber approach. For Objective 1, averaged across fertilizer-P sources, season-long CO2 emissions were almost three times greater under furrow-irrigated (23428 kg CO2 ha-1 season-1) than under flooded (8290 kg CO2 ha-1 season-1) conditions, mean season-long CH4 emissions were 10 times greater ($P < 0.05$) under flooded (29.4 kg CH4 ha-1 season-1) than under furrow-irrigated conditions (2.9 kg CH4 ha-1 season-1), and four times lower ($P < 0.05$) with ECST (3.4 kg CH4 ha-1 season-1) than other fertilizer-P sources, while mean GWP under furrow-irrigated conditions was almost 40% lower ($P < 0.05$) than under flooded conditions. Slow-release fertilizers, such as ECST, could be an effective mitigation tool to reduce GHG emissions from furrow-irrigated rice. For Objective 2, season-long N2O emissions were greater ($P = 0.02$) from the UC (i.e., 5.97 kg ha-1 season-1), which did not differ from ECST, and were lowest from ESN (1.50 kg ha-1 season-1), which did not differ from TSP, CPST, ECST, and DAP. Global warming potential was greatest ($P < 0.05$) from the UC (1612 kg CO2 eq. ha-1 season-1), which did not differ from ECST, and was lowest from ESN (1612 kg CO2 eq. ha-1 season-1), which did not differ from TSP, ECST, CPST, and DAP. The combination of numerically greater yield and lower N2O emissions from CPST and ESN suggested that slow-release fertilizers could constitute an effective mitigation tool to reduce GHG emissions, maintain production, and improve sustainability in furrow-irrigated rice systems.

Subject: Conservation on the Edge

Location: Room 203 on Upper Level

Time: 3:30 PM - 5:00 PM

Championing Conservation: The Intersection of Outdoor Heritage, Economic Impact, and Legislative Advocacy for Soil and Water Conservation

Authors: *Jamelle H Ellis (TRCP)**

Climate change is ushering in a new era of challenges, marked by increasingly frequent and severe weather events. This shift, coupled with changes in land use, is reshaping the migration patterns of fish and wildlife, contributing to habitat loss, and fundamentally impacting the hunting and fishing community. In turn, this transformation directly affects the 4.5 million U.S. jobs supported by the hunting, fishing, and outdoor recreation sectors. Hunters and anglers, historically at the forefront of wildlife conservation efforts, are crucial voices in preserving America's natural resources. The Theodore Roosevelt Conservation Partnership (TRCP) stands as a key convener of these voices, representing the 101.6 million Americans who engaged in hunting, fishing, and wildlife-watching in 2021. The economic significance of outdoor recreation cannot be overstated, with an annual output of $862 billion, surpassing industries like mining, utilities, farming, ranching, and chemical products manufacturing. This presentation provides an overview of TRCP's role in advancing legislation that influences water resources, forest ecosystems, and agricultural lands at the national level, including the Voluntary Public Access and Habitat Incentive Program. Crucially, the impact of these conservation efforts extends to soil and water conservation. The health of our soil and water resources is intricately linked to fish and wildlife habitat. TRCP's initiatives and partner engagement are vital in promoting sustainable land management practices that benefit soil health, water quality, and overall ecosystem resilience. Highlighting the symbiotic relationship between hunters and anglers, economic impact, and soil and water conservation, this presentation showcases how TRCP's advocacy supports the preservation of natural habitats and contributes to mitigating the adverse effects of climate change on soil and water resources.

Compost Socks, Blankets, and Filters for Erosion Control and Soil Moisture Retention

Authors: *Jean F Bonhotal (Cornell Waste Management Instituite)**

Use of compost, a recycled organic material, for controlling erosion and sedimentation can reduce costs, increase effectiveness and promote environmental protection. Compost applications have been used to reduce soil loss and improve soil moisture retention. Application of compost blankets can stabilize slopes and compost filter berms can filter and slow the flow of moving water. The use of a compost blanket (a layer of compost spread or blown onto a slope to a depth of 1-4 inches) has been shown to reduce runoff and erosion by absorbing rainfall impact and retaining water. Organic Material is useful in late season construction, controlling erosion before vegetation can be established.

Filter berms (a triangular dike of compost placed perpendicular to sheet flow) offer advantages over traditional measures such as silt fences and straw bales including the ability to filter out fine particles. Properties of composts such as high-water holding capacity, high organic matter content, particle size, nutrient content can be beneficial in choosing the right soil medium.

Finding Alternative Nutrient Reduction Wetland Sites to Reduce Permitting Hurdles

Authors: *Caleb D Rasmussen (ISG)**

As funding and interest for nutrient reduction wetlands increase, more headwinds are being met in the form of permitting. This presentation will explore potential alternatives to what we think of as traditional nutrient reduction wetland creation while trying to minimize permitting and current efforts in the State of Iowa, while responsibly expiditing wetland siting and design. Several wetland creation methods with varying drainage areas are used to evaluate design time, effort, and potential costs associated with each.

Investigation of Nutrient and Sediment Effluent Reduction Associated with Cover Crop-Reduced Tillage Best Management Practices

Authors: *Mark J Hill (Mississippi State University)*; Beth H Baker (Mississippi State University); Kristine O. Evans (Mississippi State University); John Ramirez-Avila (Mississippi State University)*

Nutrient enrichment from agricultural landscapes to receiving waterbodies is a contributing factor to habitat degradation worldwide. Excess fertilizer runoff in the upper and lower Mississippi River Basin is a primary driver of a large seasonal hypoxic zone in the Gulf of Mexico. This study examined the impact of combined agricultural best management practices, cover crop and reduced tillage, on water quality indicators, specifically nutrient and sediment loading from row-crop fields in western Mississippi. A paired-field study was established with edge-of-field water monitoring stations to measure discharge and collect runoff samples. The treatment was compared to a conventional farmer management control. Experimental sites were established at eleven working farms and operated over the course of three years (n=134). Assessed water quality indicators were total suspended solids, turbidity, nitrate-nitrite nitrogen, total Kjeldahl nitrogen, total nitrogen, orthophosphate, and total phosphorus. Relative reductions were calculated and analysis of paired water quality samples was performed using the Wilcoxon signed-rank test. Increased runoff volume was observed ($p=0.024$), which when coupled with modest decreases in total nitrogen, suspended solids, and phosphorus concentrations, resulted in no net change in transport ($p>0.1$). Nitrate-nitrite N concentrations and loads were significantly reduced ($p<0.01$, $p=0.03$). Use of cover crop-reduced tillage practices may help assuage nutrient enrichment concerns to aquatic ecosystems, particularly when considering exogenous N fertilizers. However, said practices may be detrimental to P limited aquatic ecosystems through increases to orthophosphate transport ($p<0.01$). Farm management practices can have a demonstrable impact on non-point source water pollution from

fields in the study region. Further investigation is warranted to delve into the mechanisms underlying the observed increase in discharge associated with the treatment.

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Location: Room 204 on Upper Level

Time: 3:30 PM - 5:00 PM

Construction Stormwater Activities: Making a Difference in America's Amazon

Authors: *Earl L Norton (SWCS AL Chapter)*; Perry Oakes (AL Soil and Water Conservation Committee)*

Construction stormwater activities addressing erosion and sediment control (ESC) in Alabama have reached a high plateau during recent years. These activities are important to professionals and other involved in managing stormwater to protect streams, lakes, rivers, and related environments. Alabama programs have produced products like the Blue Book and a Field Guide which include BMPs based on available research, Seminars and Field Days, Lunch and Learn activities, Erosion and Sediment Control Tips to a large mailing list, Erosion and Sediment Control research, a new Alabama Stormwater Association, and participation with several committees of the International Erosion Control Association. Learn how the Alabama Chapter of the SWCS and its members collaborate with other professionals and contribute to many of these activities that significantly benefit the environment and citizens of Alabama. The presentation provides information that can serve as a template for professionals in other states with similar opportunities.

Fostering Collaboration and Documenting Impact with Field to Market: The Alliance for Sustainable Agriculture

Authors: *Sydney Mucha (Field to Market: The Alliance for Sustainable Agriculture)*; Austin Pearce (Field to Market: The Alliance for Sustainable Agriculture); Kelly M Young (Field to Market: The Alliance for Sustainable Agriculture)*

Driving the adoption of conservation agriculture practices at scale requires collaboration among all sectors of the supply chain, from farmers to agribusinesses to consumer packaged goods companies. Field to Market: The Alliance for Sustainable Agriculture is a 501c3 that plays a pivotal role in uniting the supply chain to define, advance and measure sustainability outcomes from commodity crop production in the United States using an approach that is science-based, technology neutral and puts farmers at the center. This presentation will highlight Field to Market's tools and programs that foster collaboration among supply chain actors, conservation organizations, academia and governments to collectively advance interventions to support growers as they adopt practices and systems to improve agriculture's impact on the environment. Attendees will gain insights into how they can contribute to the ongoing efforts of Field to Market and similar initiatives, fostering a broader movement toward sustainable agriculture practices.

Leveraging Partnerships to Drive Conservation Adoption

Authors: *Benjamin Porepp (Iowa Soybean Association)*; Brandon Iddings (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 are growing by the year. This means that the number of organizations and entities required to implement conservation practices has skyrocketed. The Iowa Soybean Association (ISA)has championed leveraging partnerships in both the public and private sectors. A few examples include embedding a conservation agronomist network into ag retail, expanding partnerships between row crop agriculture and environmentally focused entities, and delivering numerous federal, state, and private grants to the farm level. These partnerships are critical to catalyzing conservation adoption across Iowa.

The presentation will begin with a brief introduction to the ISA Conservation team and an overview of our roles in promoting conservation across Iowa. The presentation will profile how ISA Conservation Agronomists and Conservation Services Managers leverage retail partnerships, along with financial and technical planning/assistance, to enhance and drive conservation adoption. Secondly, attendees will explore how ISA has leveraged unlikely partners, and the expertise they provide, to enhance delivery to Iowa's landowners. The attendees of this presentation will better understand how partnerships are essential to scaling up conservation across the landscape. At the end of this presentation, new ideas will be shared on how to develop partnerships in their own regions and organizations.

Subject: Outreach, Education, and Community Engagement

Location: Room 206 on Upper Level

Time: 3:30 PM - 5:00 PM

Barriers to Equity in Delivering Conservation

Authors: *Jill Reinhart (USDA-NRCS)**

NRCS and their conservation partners have been making an extra effort to reach historically underserved producers, including minority, veteran, beginning and limited resource farmers. The Farm Bill includes provisions that address the unique circumstances and concerns of historically underserved producers. All federal agencies have been directed to advance racial equity and support for underserved communities (Executive Order 13985), and equity is a priority in the NRCS Strategic Plan.

The Equity in Conservation Outreach Cooperative Agreements have provided $120 million dollars to partners that can help the agency reach producers that aren't aware of NRCS programs and services. These agreements build awareness and build relationships to lead to increased engagement with underserved producers and communities. These agreements have also provided insights into the barriers that underserved producers are facing that can inform all conservation organizations in their work towards equity.

NRCS' Outreach and Partnerships Division reviewed the work of the recipients of Equity in Conservation Outreach Cooperative Agreements. Partners reported back from workshops, focus groups and individual conversations and painted a picture of common barriers to equitable participation including: awareness, communication, financial, time frame/process, cultural and control of land. This presentation will detail the barriers identified, provide examples of projects working to overcome these barriers, and share steps to overcoming barriers in the future.

NRCS and all conservation organizations can utilize the insights from the Equity in Conservation Outreach projects to inform their work reaching historically underserved producers and communities. By working to overcome identified barriers and build trusted relationships, conservation programs and services can be utilized by all producers, increasing participation by producers that are new to farming, are low-income, identify as one or more marginalized race or ethnicity, and/or are military veterans.

Note: If any of the recipients of Equity in Conservation Outreach Cooperation Agreements are attending the conference, they will be invited to and recognized during the session!

Conservation Districts: Boosting Community Engagement

Authors: *Nick Walker (Lexington Soil & Water Conservation District)**

The program will cover a brief history of Conservation Districts, how they contribute to society by hosting workshops, in-school programs, seed libraries etc., and how they act as intermediaries

between the general public and organizations that focus on agricultural and conservation efforts. I'll also discuss the role of Commissioners and how Conservation Districts have evolved to keep up with advancements.

Interactive Communication: Bridging Science and Society for Sustainable Natural Resource Management

Authors: *PARMVEER SINGH (The Pennsylvania State University); Anil K Kumar Chaudhary (The Pennsylvania State University)**

The research impact is viewed through the lens of the application of the research findings by the end users. However, the one-way dissemination of the research primarily takes place through research papers, and academic conferences that limit the access to information, application of knowledge, and underachieved impact of the research. In the context of transdisciplinary research (TDR), knowledge production takes place through mutual learning processes that essentially require both scientific and non-scientific stakeholders (e.g., farmers and nonprofit organizations) to work on a problem of common interest. Therefore, one-way knowledge dissemination does not suffice as it only allows the sharing of the information but lacks participation of non-academic participants throughout the research process. To narrow this gap, there needs to be a comprehensive framework that defines possible interlinkages at different research stages and transparency in roles, responsibilities, and expectations between both parties. In addition to this, an evaluative criterion that helps to gauge the effectiveness of such collaboration of both parties is also needed. The need for a communication framework was felt in the USDA NIFA-funded TDR project. Acknowledging the drawbacks of the unidirectional flow of information, using extensive literature review, we propose an interactive framework of communication that links the contextual conditions, stakeholder participation, knowledge integration, dissemination strategy, and evaluation of the output, outcomes, and impact. Our framework primarily intends to overcome the above-described limitations by offering strategic plans that incorporate social media channels (e.g., YouTube, Facebook, Twitter), documents (e.g., factsheets, policy briefs), evaluation metrics, and engagement strategies. Guided by the literature, our current model has scope for application in environmental sustainability projects. Moreover, the selection of stakeholder contextually relevant dissemination outlets for sharing information helps attract wider users to enhance its reach. We further plan to test and validate this model in a large USDA NIFA-funded project to determine its effectiveness and further finetune it. Additionally, the current framework has implications for researchers, conservation, and extension professionals engaged in large teams striving to solve complex problems, for which a reliable and efficient communication strategy is the only solution.

The Snowball of Leveraging Conservation Research for Virtual Education

Authors: *Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service)*; Rita Watson (University of Arkansas System Division of Agriculture); Julie Robinson (University of Arkansas System Division of Agriculture); Mike Daniels (University of Arkansas System*

Division of Agriculture Cooperative Extension Service); Diedre Young (University of Arkansas System Division of Agriculture); Kerry Rodtnick (University of Arkansas System Division of Agriculture); Samantha Barker (University of Arkansas System Division of Agriculture)

Beginning in 2018, the UofA System Division of Ag integrated the applied research efforts of the AR Discovery Farms Program to develop & deliver virtual field trips (VFTs) i.e. live streamed webinar style demonstration & educational experiences to an global audience. Virtual participation in VFTs provide time & cost savings. Demonstrations & educational sessions provided include virtual demonstrations of conservation benefits with respect to water quality, irrigation water use, climate change, soil health, & profitability/sustainability on selected research partner farms, including existing Discovery Farms & soil health observation farms. Delivery of virtual educational opportunities & lesson plans related to soil health & water quality are available for K-12 science classes in a 45 min – 1 hour time frames that teachers can incorporate into school day curriculum, emphasizing conservation benefits with respect to water quality, irrigation water use, climate change, soil health, & careers in conservation & agriculture. Recorded virtual field demonstrations are available online, along with the lesson plans for K-12 science teachers. Lesson plans follow Next Generation Science Standards in the E7 & GRC formats. Virtual Field Trips were also registered with the Arkansas Department of Education for high school science teachers to receive Continuing Education Units (CEU) for participating in the live VFTs. The VFT series concluded in July of 2021 with 14 webinars & had 3,798 live viewers. All VFTs were uploaded to YouTube & to date, have over 11,000 & counting YouTube Views. The success of the VFT series laid the groundwork & has been instrumental in the development & delivery of several similar follow up projects, including the Arkansas Conservation Partnership webinar series, Arkansas Soil and Water Education Conference, & Arkansas Future Ag Leaders Tour. The team behind the VFT series now assist with multiple state conservation agency's virtual education efforts.

Subject: Water Resource Assessment and Management

Location: Room 208 on Upper Level

Time: 3:30 PM - 5:00 PM

Biological Sensitivity to Common Environmental Pollutants: A Deep Dive into a Watershed's Ecological Condition

Authors: *Laura M Bates (UW-Madison)*; Anita Thompson (University of Wisconsin-Madison)*

Diatoms and macroinvertebrates have served as a foundation for indicating the ecological condition of freshwater streams for years. Statewide standards for environmental pollutants can serve as an excellent starting-point for water quality monitoring, but the complexities and interactions between biological assemblages and environmental stressors warrants a closer look at smaller-scale associations. Despite ongoing water quality monitoring, Wisconsin's streams and lakes are suffering from, or under severe threat of, eutrophic conditions. Significant management efforts to reduce phosphorus loading are required to offset the effects of phosphorus and climate change. Clear and concise information on local stream ecological condition and water quality can help in achieving nutrient reduction goals more effectively and efficiently. This research used non-metric multidimensional scaling (NMDS) to evaluate biological sensitivity with common environmental pollutants to explore why individual streams within the Green Lake Watershed are exhibiting certain ecological conditions. Though preliminary results have shown that biological abundance fluctuates with increasing or decreasing nutrient concentrations, they also respond positively to streams that have undergone riparian streambank restoration, and to streams that do not exceed Wisconsin's criterion for total phosphorus. These findings indicate that streambank restoration projects have been effective at supporting biological species, but the complexities with nutrient interactions and with other environmental pollutants warrants a need for increased local water quality monitoring efforts, especially for diatoms. Results of this study can help advise and advocate for future nutrient reduction strategies and demonstrate the need for increased local biological and water quality monitoring assessments in all watersheds that face the ongoing challenge of preventing eutrophic conditions.

Evaluating the Impact of Cover Cropping on Water Dynamics in a Young Pistachio Orchard: A Soil-Water Budget Approach

Authors: *Charlie Chen (University of California Davis)*; Matthew Roby (USDA-ARS Sustainable Agricultural Water Systems Research); Anish Sapkota (USDA-ARS Sustainable Agricultural Water Systems Research and University of California, Davis); Isaya Kisekka (University of California, Davis)*

Cover cropping has emerged as a climate-smart solution with documented benefits for soil health, including enhanced water infiltration, reduced soil erosion, and improved crop yields. Despite these advantages, the adoption of cover crops in semi-arid regions, particularly in California, has been limited due to uncertainty surrounding their potential impact on water consumption. Here we address this knowledge gap by employing a soil water budget approach to assess the influence of

cover crops on evapotranspiration and the spatiotemporal soil water dynamics in a young pistachio orchard established in 2018 near Woodland, CA in the southern Sacramento Valley. The 64-hectare commercial orchard featuring the Golden Hill cultivar was divided into two sections: one designated for cover crop cultivation (CC) and the other left without cover crops (NCC). Instrumentation in the orchards includes eddy covariance towers, cosmic ray soil moisture sensors, and neutron probe access tubes installed to a depth of three meters. In each orchard, soil moisture was measured using neutron attenuation in replicated transects (n=4) of access tubes installed at four points along a gradient between the tree line and interrow. Additionally, one tree in each orchard was instrumented with a high-density array of access tubes to explore how cover crops influence three-dimensional soil water distribution and root water uptake over time. Preliminary findings from data collected between October and December 2023 indicate that cover crops influence soil water storage by reducing soil moisture in the uppermost meter of soil but facilitate deeper water penetration (> 1.5 m). Soil water budgets for the 2024 growing season will be separately calculated for NCC and CC orchards, with ongoing assessments planned for the 2025 season as well. The outcomes of this research are expected to provide crucial insights into cover crop impacts on soil water storage for growers contemplating cover crop adoption in their orchards. Subsequent research could extend these investigations to young and mature pistachio orchards in the broader Central Valley or explore the influence of different cover crop compositions on soil water dynamics.

From Forgotten to Critical Resource: Planning for the Future with Wetlands

Authors: *Michaela Lambert (Kentucky Division of Water)**

Natural wetlands compromise just 6% of the earth's surface but are disproportionate in their function and biodiversity. Wetlands provide ecologically and economically important services, such as water storage, flood regulation, ground and surface water recharge, contaminant filtration and absorption, nutrient cycling, carbon storage, and critical habitat that supports a diversity of aquatic and terrestrial life. Both natural and restored wetlands have been shown to improve water quality through the sequestration or transformation of nonpoint source pollutants by trapping and slowing potentially erosive stormwater. It's estimated that, on a per-hectare basis, estuaries and freshwater floodplains/swamps were the world's two most valuable ecosystem types. However, wetlands worldwide have been drained for human uses including urban and agricultural purposes, disease management, and water transport. More than 22 states have lost more than half of their wetlands in the last 22 years. In Kentucky alone, over 80% of the natural wetlands have been lost. Because of their potential services and values, wetlands should be incorporated in watershed planning but are frequently left out. The Kentucky Division of Water and partners have created two tools that can be used to incorporate wetlands in planning, the KY Wetlands Rapid Assessment Method and the Wetlands Prioritization Tool. Kentucky's Nonpoint Source Management Program is taking several steps to incorporate wetlands more formally into its watershed planning, including the use of these tools. This presentation will discuss the importance of incorporating wetland resources into planning, how Kentucky's Nonpoint Source Program is taking the steps to formally incorporate

wetlands into watershed planning, introduce some tools to assist in the process, and showcase some success stories within the Commonwealth of Kentucky.

Fuzzy Multi-Objective Optimization for Sustainable Agricultural Water Management of Irrigation Networks

Authors: *Nargis Mirzaie (Umass Amherst)*; S. Mehdy Hashemy Sshahdany (University of Tehran); Saeed Mozaffari (University of Tehran); Timothy O Randhir (University of Massachusetts)*

Water demand in urban, industrial, and agricultural sectors has significantly increased in recent decades, and agricultural water supply faces constraints due to competition from non-agricultural uses. Sustainable water resource management requires optimal use of water resources, especially in water deficit and arid regions. Moreover, uncertainties of the economic and hydro-climatic variables and parameters should be part of sustainable agricultural water resources management. In the present study, the Varamin irrigation network in Iran is assessed to resolve water shortage under uncertainties in the parameters, objective functions, and constraints regarding the challenge of nitrate pollution. A Fuzzy Multi-Objective Particle Swarm Optimization (F-MOPSO) is applied to maximize the net benefit, groundwater restoration, and minimize nitrate leaching into the aquifer in this irrigation network to address Sustainable Water Resources Management (SWRM). The results demonstrate that this fuzzy model can handle uncertainties in irrigation system networks with a sustainable water use perspective. The net benefit is significantly increased up to 21% due to allocating more reclaimed wastewater instead of groundwater and obtaining more income from the optimal cropping pattern. Nitrate leaching decreased by 34% with a reduction in consumption of nitrogenous fertilizer. Furthermore, there is an 82% improvement in groundwater restoration using the fuzzy MOPSO Kumar optimization model. A multi-objective optimization with uncertainties will help users and decision-makers make realistic decisions for irrigation networks. This research can assist decision-makers within the domain of water, agriculture, and the environment in finding sustainable water solutions and improving the current water consumption practices considering environmental aspects of nitrogen leaching in other regions by applying the proposed fuzzy model.

TUESDAY, JULY 23

ORAL PRESENTATION DESCRIPTIONS AND AGENDA

Subject: Adaptive Management of Conservation Efforts

Location: Room 202 on Upper Level

Time: 10:30 AM - 12:00 PM

Evaluating the Role of Grazing Strategies on Plant Production and Soil Health Across a Decade Timescale

Authors: *Merilynn C Schantz (USDA-ARS)*; Kabindra Adhidari (USDA-ARS); Douglas Smith (USDA-ARS); Jeff Goodwin (Texas A&M University); Doug Tolleson (Texas A&M University); Daren Harmel (USDA-ARS)*

Frequent and extreme climate events threaten the ecological integrity of range and pasture lands across the United States. Producing resilient soil and plant communities that can withstand frequent disturbances reduces the environmental and economic costs associated with responding to these disturbances. The pasture use and grazing strategy is an often-overlooked variable that can directly affect ecosystem resilience across watersheds. In the southern Great Plains of central Texas, the USDA-ARS Grassland, Soil, and Water Laboratory has a mission of developing technology and solutions that increase efficient use of soil and water resources, enhance forage and crop production, and support sustainable agricultural production in healthy ecosystems. For this study, we sought to determine how plant production and soil health differed between rotational, conventional year-long, and cultivated grazed pastures over a 10-year period. Our initial results suggest that the rotational grazing system produced higher plant production during drought conditions when compared to conventional year-long grazing systems. While organic matter did not differ between rotational and conventional grazing systems, it was higher than cultivated grazed pastures. These findings suggest that adaptive grazing strategies may be more resilient to climatic disturbances that disrupt the ecological structure and function of southern Great Plains ecosystems.

Quantifying the Co-Benefits of Combined Regenerative Agriculture Practices with Poultry Manure Management in a Corn-Soybean System

Authors: *Natasha L Hoover (Iowa State University)*; Michelle Soupir (Iowa State University); Daniel Andersen (Iowa State University); Rameshwar Kanwar (Iowa State University)*

Expansion of agricultural production has irrevocably altered the earth's landscape, impacting soil health, water quality, and climate patterns. Strategic application of poultry manure in concert with other regenerative agriculture practices, specifically cover crops and reduced tillage, hold promise

in wide-ranging environmental benefits. While much is known about these practices individually, we lack information about their interactions on environmental and agronomic outcomes. Details from the first years (2021-2024) of research at Iowa State University Agricultural Engineering and Agronomy Research Farm's LAiYERS (Land mAnagement for improved Yields, Environmental Resilience, and Sustainability) site will begin to answer these questions. Twenty-seven ¼ acre sized plots were established in 2021 with the installation of a central subsurface drainage tile line through each plot. Electrical was installed at the plots in 2023, and the individual tiles were instrumented for drainage flow measurement and sample collection. Treatments include Urea Ammonium Nitrate (UAN) chemical fertilizer and/or poultry manure applied in the late winter preceding, or the spring of, a corn year in a corn-soybean rotation. Multiple research teams have collaborated to evaluate the impact of combined regenerative agriculture practices, including reduced tillage and cover crops with poultry manure management, on water quality, soil health, carbon and nitrogen transformation and availability, and greenhouse gas potential. Early results indicate a multi-year average water quality benefit with spring applied manure compared to UAN treatments and early winter applied poultry manure treatments. Cover crops did not impact water quality during the first years of the study but had variable impact on crop yields. Corn yields were not significantly different with cover crops in 2022, with a small increase in yields with cover crops measured for most treatments. A significant decrease in soybean yields with cover crops in 2023 was attributed to late termination of the cereal rye. Elevated soil phosphorus levels were measured after manure application for the 2022 corn season in the poultry manure plots, with increases measured in the following soybean year (2023) after manure application. Continued research will evaluate changes in soil health, nitrogen and carbon transformation, and potential greenhouse gas emissions under the various treatment management practices.

Soil Loss and Nutrient Mobilization in Runoff and Infiltrate as Affected by Manure Type and Their Rate of Application

Authors: *Bhupinder S Jatana (Clemson University)*; Quirine Ketterings (Cornell University)*

Raw dairy manure and derived products including separated liquids and various types of solids, that vary in physiochemical properties, may influence soil erosion and nutrient movements in case of runoff and infiltrate when applied as a nutrient source. Rainfall simulation studies were conducted in central New York, to evaluate the impact of raw dairy manure versus separated liquids, separated solids, dissolved air flotation (DAF) solids, and Sedron solids on rainfall partitioning (runoff versus infiltration), sediment loss, and nitrogen and phosphorus loss in runoff and infiltrate. Experiments were conducted in three replications using five phosphorus application rates (from 0 kg P/ha to 100 kg P/ha). Raw manure increased rainfall infiltration and lowered both runoff volume (18-40%) and sediment loss (>85%) in the runoff. Separated solids and Sedron solids also reduced soil loss but to a smaller extent (35-50%). The application of DAF solids did not reduce sediment loss. Most of the nitrogen and phosphorus loss occurred as runoff loss during the 1st rainfall event, and nitrogen and phosphorus loss increased with application rate. Phosphorus loss was highest with separated solids and Sedron solids, comparable between raw manure and DAF solids, and lowest with separated

liquids. Reflecting that each source was applied at the same phosphorus application rate, separated liquids resulted in the highest nitrogen loss followed by separated solids, raw manure, and then DAF and Sedron solids. These results suggest future P loss assessment tools should take manure product differences into account when setting upper limits to application rates.

Yield Stability Assessment in Long-Term Dryland Wheat Production

Authors: *Maysoon M Mikha (USDA-ARS)*; Cody Creech (University of Nebraska-Lincoln); Lawrence Aula (University of Nebraska-Lincoln); Amanda Easterly (University of Nebraska-Lincoln)*

Yield stability analysis in long-term studies could be a useful tool in interpreting year-to-year variability in crop production influenced by different environments and land management. This study evaluated long-term winter-wheat grain yield stability under different tillage practices. The study was initiated in 1970 with winter wheat-fallow rotation at the High Plains Agricultural Laboratory (HPAL) near Sidney, Nebraska (NE) on Duroc loam soil with ≤ 1% slope. Three tillage practices were implemented, no-tillage (NT), stubble mulch (SM), and moldboard plow (MP). Throughout the years, average wheat grain yield was about 2.60 Mg ha-1 with NT and 2.63 Mg ha-1 for MP and SM practices. Tillage alone did not significantly influence wheat yield. The influence of years and their interaction with tillage on yield was significant ($P \leq 0.01$) and mostly related to environmental factors associated with each year within the study period. Yield was positively correlated to precipitation while negatively influenced by ambient temperature. The stability analysis (yield vs. environment) showed that minor changes in environment had no influence on changes in yield. The SM practice showed a potential for yield stability under different environments compared with NT and MP practices. In general, significant grain yield stability was associated with the SM which could be related to soil properties improvement that improved yield resiliency under different environmental conditions. Further research regarding soil properties needs to be examined to relate soil properties and nutrient dynamics to yield stability under different tillage practices.

Subject: Conservation Models, Tools, and Technologies

Location: Room 204 on Upper Level

Time: 10:30 AM - 12:00 PM

Cattle, Conservation, and Community

Authors: *Erin Ogle (Taylor Co SWCD)**

As commodity prices have increased over the years, producers have been known to try to 'change their land to fit their management' when it comes to crop production systems. This is not ideal. Historically, the rolling hills of Southwest Iowa were dominated by pasture and hay production with only the relatively level bottom lands and ridges being row cropped. Over time, farms became increasingly less diversified while at the same time, rising commodity prices drove a shift in land use towards row crop production on the majority of the acres in the county. This trend towards continuous row crop systems on all acres, brought into production the marginal and highly erosive sidehills that were once in grass production.

Row crop farming on these sidehills increases runoff and can degrade resources. Additionally, continuous row cropping on these marginal lands further leads to decreased productivity; and ultimately, profitability on these sensitive lands. Taking into consideration these environmental, economic concerns, most would agree that the long-term sustainability of this model is questionable. Sustainable alternatives were needed to meet the needs of a wide variety of producers and their individual operations. In other words, viable and practical options were needed to break the cycle of continuous row crop production. Designed to give these lands a break, grass-based and sustainable alternatives were developed to meet forage shortfalls and make long-term improvements in soil health. These alternatives offered a variety in the level of commitment for the producer from one year to multiple years depending upon individual comfort levels and needs. For example, some producers are willing to implement cover crops which is a one-year commitment, whereas others are open to permanent pasture with a longer commitment.

As part of the Iowa Nutrient Reduction Strategy, watershed projects throughout Iowa have been established to focus on agricultural and urban conservation practices to help improve water quality. Since 2016, southwest Iowa has demonstrated how effective a grassroots project can contribute to water quality, soil health, return on investment (ROI), and the local community by simply seeding marginal row crop acres to forage and incorporating livestock.

This presentation will touch on how getting livestock back on the SW Iowa landscape is beneficial for the environment, pocketbook, and community. Data will be shared on soil health and water quality from forage-based conservation practices as well as the return on investment for producers who are focusing on finding an alternative to farming their marginal acres. With combining geospatial decision-making tools, state and federal cost-share dollars, and community support, the expansion of a single county demonstration water quality project continues to leave a positive impact as it is currently expanding throughout Iowa.

Incentivizing Phosphorus Reduction in the Kalamazoo River Watershed via Novel Reverse Auction Program

Authors: *Lucas Chamberlain (Delta Institute)**

Supported by the US EPA's Great Lakes Restoration Initiative, this 4-year collaboration between Delta Institute, Allegan Conservation District, and Michigan Farm Bureau was designed to reduce phosphorus runoff to Lake Michigan from agricultural fields through a performance-based incentive program.

This project provides a novel, market-based solution to reducing nutrient runoff into waterways. Farmers were engaged to adopt conservation practices (e.g., cover crops, no-till) at targeted locations in the Kalamazoo River watershed to reduce phosphorus loading. A series of unique "reverse auctions" were performed to allow producers to set their own price for the phosphorus runoff reductions they're creating by adopting soil conservation practices. Direct payments were made to producers following bi-annual verifications of the implementation of conservation practices.

Progress was measured by estimated pounds of phosphorus reductions via The Great Lakes Watershed Management System (GLWMS) run using the Spreadsheet Tool for Estimating Pollutant Loads (STEPL) as well as the number of acres receiving technical or financial assistance on nutrient management in priority watersheds.

In total, five producers engaged in the program and received a cumulative sum of $152,952.72 to implement 981.5 acres of soil conservation BMPs across 30 agricultural fields – spanning 2070.4 acres total. The implementation of soil conservation practices reduced phosphorus runoff into the Kalamazoo River Watershed by an estimated 5,452.74 lbs. and reduced nitrogen runoff by an estimated 14,480.06 lbs.

This program represents a fundamental change from the traditional cost-sharing conservation model and demonstrates a novel, market-based approach to implementing soil conservation practices and reducing nutrient runoff into crucial watersheds of the Great Lakes. The pay-for performance program shifts the focus to investing in pollutant reductions that lead to measurable water quality improvements and paying producers for reducing the negative environmental impacts. This market-based approach is currently being applied in several Midwestern watersheds, (e.g., the Great Miami River watershed, the Ohio River Basin and the Rabbit River watershed (an ongoing GLRI funded project)) providing a solid basis for launching this in the Kalamazoo River Watershed. Performance-based conservation programs provide a more effective way of reducing nutrient pollution, as they are tied to environmental outcomes and offer a way to begin an ecosystem-focused, sustainable approach to land management and farming.

Modeling Soil Moisture Content of Mixed Perennial Bioenergy Grasses in Western Nebraska Using Machine Learning

Authors: *Jules Cacho (Argonne National Laboratory)*; Jeremy Feinstein (Argonne National Laboratory); Colleen Zumpf (Argonne National Laboratory); John Quinn (Argonne National Lab); Julie Peterson (University of Nebraska-Lincoln); Daren Redfearn (University of Nebraska-Lincoln); Cristina Negri (Argonne National Laboratory)*

Groundwater depletion is a major concern in the irrigation-dependent crop production system of the U.S. Northern Great Plains region, which heavily relies on the Ogallala aquifer. Increasing irrigation demands due to frequent occurrences of drought in a changing climate can further deplete the Ogallala aquifer. This study evaluates the viability of growing rain-fed perennial warm-season grass species for bioenergy and biomass-based products to targeted sites within these irrigated landscapes to help minimize the stress on the groundwater resources of the region and provide potential benefits to insects and wildlife, which have been severely affected by habitat loss due to conversion of native grasslands to irrigated row crop production. Six paired agricultural fields in Western Nebraska, consisting of an irrigated crop (CROP - corn or soybean) field and a nearby Conservation Reservation Program (CRP) mixed perennial grass field (a proxy for native switchgrass and mixed grass species), are used as study sites. Soil moisture content (SMC) data are continuously monitored at three depths (1ft, 2ft, and 3ft) from these agricultural fields and are used to train and test machine learning (ML) - based models. Results showed, using two years (2022-2023) of data, that ML-based models can accurately estimate daily SMC (at 1 ft depth, mean of 1-2 ft, and mean of 1-3 ft) in both fields and specify the top explanatory variables ranked in order of importance. We expect the predictive capabilities of these models to improve when another two years (2024-2025) of SMC data become available for further model training and testing. Results from this study can provide valuable data and tools that are necessary to understand the water quantity benefits from integrating rain-fed native perennial bioenergy grasses within irrigated CROP fields in the Northern Great Plains at higher spatial resolution. Specifically, the developed ML-based SMC models can be integrated into satellite-based evapotranspiration (ET) models to overcome their challenges of estimating ET during cloudy days.

Validation of Arachis pintoi as a Conservation Cover to Improve Soil Health on Coffee Plantations in the Mountainous Region of Puerto Rico

Authors: *Edrick Marrero soto (USDA-NRCS)*

Coffee production has been an important part of Puerto Rico agriculture since 1736. Production is mainly in the central mountainous region of the island with slopes averaging from 20 to 60%, temperatures ranging between 55 and 85 ºF and an average precipitation of 50 to 90 inches of rain annually. The use of conservation covers is a highly recommended practice for this area to improve soil health, increase water infiltration, reduce the use of chemicals for weed control, reduce the erosion of the soil and foster climate smart coffee plantations. A conservation cover like Arachis pintoi could greatly reduce erosion on steep terrain, reduce dependence on herbicides, increase water infiltration and improve the soil health in tropical environments. The objective of this project is to evaluate Arachis pintoi as a conservation cover to improve soil health and foster climate smart practices on coffee plantations in Puerto Rico. Five farms in three municipalities (Lares, Jayuya,

Utuado) were selected to establish a 1,000 m2 planting area of Arachis pintoi as a conservation cover. In each planting area, three one-square meter observational plots were randomly selected to measure cover area of Arachis pintoi and biological diversity for a period of six months. A one-meter square tool divided in four segments was designed to collect data form the plots identified. After the six-month period, we observed a great variability among the five farms in Arachis pintoi cover percentage, which ranged from 93%, to 5%, 41%, 11% and 55% after planting. Less shaded plots had a greater cover area percentage of Arachis pintoi than heavily shaded ones. The difference in covered area may be related to shade percentage, precipitation, coffee field management and other factors. Biological diversity was documented by observation of the identified plots. Before planting the cover crop, the presence of ants and earthworms was documented; six months after planting the cover crop a great diversity of animals was documented including bees, wasp, butterflies, flies, spiders, ants, earworms, centipedes, fungi, springtails, demonstrating the benefits of using cover crops to increase biological diversity in the soil. Arachis pintoi can be an option as a conservation cover in coffee plantations in the montainous region of Puerto Rico. Further research and data collection are needed to evaluate the factors that affect the establishment and development of Arachis pintoi as a conservation cover.

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

Location: Room 206 on Upper Level

Time: 10:30 AM - 12:00 PM

Can Low Lime Rates Be Successful in Mitigating Soil Acidity in the Northern Great Plains?

Authors: *Larry J Cihacek (North Dakota State University)**

The growth of the extent of acid soils in the Northern Great Plains is an increasing concern to farmers, land owners, ag professionals and researchers. In addition, the lack of good sources of agricultural limestone makes it difficult to economically correct soil acidity which can often be as low as pH 4.3-4.5. However, in some areas, sugar beet lime (from sugar refining operations) is available if the farmer is willing to cover transportation costs for the distance from the source to the field.. In late 2020, we established a series of field plots with rates of 0, 2 and 4 T lime/acre (0, 4.4 and 8.9 Mg/ha) on no-till cropland in southwestern North Dakota with an average rainfall of 365 mm. This was followed by annual spring and Fall soil sampling during the 2021, 2022, and 2023 growing seasons. Despite surface application of lime in a semi-arid no-till environment, we were able to generally increase soil pH by at least 0.5 pH units and often more illustrating that lime can be effective in this environment if allowed adequate time to react with the soil and in bringing the pH up to a level where it can be managed with more frequent low rate lime applications.

Impact of Conservation Tillage Strategies on Soil Health in Organic Grain Cropping Systems

Authors: *Ravi Teja KR 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)*

The rising demand for organic grains in the southeastern United States offers an opportunity for farmers to transition to organic agriculture. This shift, however, introduces challenges related to soil health due to the heavy reliance on intensive tillage to meet weed control, nutrient availability, and yield enhancement needs. Addressing these challenges resides in enhancing soil health through conservation measures such as cover cropping, minimizing tillage, diversifying crop rotations, and strategically utilizing organic amendments. This study investigates the effects of diverse tillage and management practices on soil health in organic grain systems, tailored to meet different goals of local farming communities, such as i) maximizing grain production, ii) increasing production while reducing tillage, iii) maximizing ecosystem services, and iv) improving ecosystem services without external nutrient inputs Field experiments were started in September 2020 in East and Middle Tennessee, featuring a soybean, wheat-soybean double-crop, and corn rotation over three years. The study employed a full-entry study design that allowed for the growth of all crops each year, with crop management emulating conventional agricultural practices. Crop nutritional demands were fulfilled via cover crop blends and poultry litter applications. A comprehensive analysis of soil health indicators was done at four different depths up to 60 cm. These included pH, bulk density, soil organic carbon (SOC), nitrogen (total, inorganic, and potentially mineralizable forms),

extractable nutrients, aggregate stability, microbial biomass carbon, water-extractable carbon, and permanganate oxidizable carbon (POXC). Preliminary results from the first two years showed no SOC differences at 0–5 cm depth across treatments, but notable SOC increases at 5–15 cm with manure and greater tillage intensity. POXC varied by treatment, while pH and aggregate stability differed by crop and depth. Additional statistical analyses are currently undergoing and will reveal the effects of various cropping system management practices during this transition period. This research provides vital insights for optimizing cropping practices to improve soil health in organic grain production.

Long-Term Soil Erosion Effects on Soil Hydraulic Properties with Sanborn Field

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

Soil hydraulic properties including plant available water capacity (PAW) and infiltration are two of the most important soil properties to indicate the health of a soil for potential plant productivity. Under rainfed systems grain crops are highly dependent upon water in the soil profile for plant production. Soil water infiltration and stored soil profile water are essential for this production. Soil erosion can substantially reduce water infiltration and the soil's profile available water capacity especially for soils with reduced water storage capacity in lower soil horizons. This study focused on long-term soil management effects on soil erosion and subsequent reduction in infiltration and plant available water capacity. The historic Sanborn Field provided an excellent field laboratory to study the effects of long-term soil erosion on available water capacity and infiltration. Soils in Sanborn Field are predominantly Mexico silt loam (fine, smectitic, mesic Vertic Epiaqualfs) which have 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 from in field soil water infiltration and plant available water capacity from historical plots of Sanborn Field were evaluated. Results illustrate the significant changes in these values due in large part to soil erosion that has occurred from some cropping systems. The importance of long-term soil conservation was shown for improving water storage for sustainable plant production.

Soil Health Legacy Effects of Alternative Approaches to Integrating Crop and Livestock Production

Authors: *louceline fleuridor (The Ohio State University)**

Soil health is defined as the ability of the soil to support crop productivity and provide other ecosystem services. Soil health is often measured by various indicators that can be impacted by various farm management practices. For many years, the separation of crop and livestock production and increased reliance on fertilizers and pesticides for cash-grain production has contributed to declines in soil health and impacts on water and air quality. Specialized livestock

operations also struggle to find sufficient land to appropriately utilize nutrients available in manure. Despite the potential benefits of reintegrating crop and livestock systems, the existing literature has more exclusively focused on studies done under controlled experimental conditions and fieldwork on specialized production systems. As such, there is a lack of on-farm research that assesses the collective legacy and impact of different combinations of crop and livestock integration. Here we evaluated soil health conditions across four different production systems: 1) Cash Grain farms with no history of manure 2) Cash Grain + Manure 3) Diversified Crop-Livestock with more complex crop rotations (including both perennial forage crops and cash grains in the rotation), and manure used and 4) Perennial only livestock (no cash grain) farms. We assessed the impact of these management legacies on key soil health indicators such as permanganate oxidizable carbon (POX-C), soil organic matter (SOM), carbon and nitrogen (C: N) ratios, soil aggregate stability and nutrient availability on 86 fields on 31 Ohio farms over two consecutive growing seasons. We hypothesized that the use of manure and diversified cropping rotations that include perennials will significantly improve soil physical, chemical and biological health and promote more sustainable agricultural production and enhance provision of ecosystem services.

Subject: Water Resource Assessment and Management

Location: Room 208 on Upper Level

Time: 10:30 AM - 12:00 PM

Advancing Nutrient Reductions through the Gulf Hypoxia Task Force

Authors: *Addison B Walsh (US EPA)*; Whitney M King (EPA)*

The Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) is a collaboration of 5 federal agencies, 12 states bordering the Mississippi and Ohio Rivers, and the National Tribal Water Council on behalf of Tribes. Three multi-state sub-basin committees and a Land Grant University (LGU) Consortium are key partners. The HTF was established to understand the causes and effects of eutrophication in the Gulf of Mexico and to coordinate activities to reduce the size, severity, and duration of the hypoxic zone. The HTF works collaboratively and voluntarily on reducing excess nitrogen and phosphorus loads delivered from the Mississippi and Atchafalaya River Basin (MARB) in order to reduce the size of the Gulf hypoxic zone. For the first time, the HTF received sustained funding of $60 million through the Bipartisan Infrastructure Law (BIL) to advance nutrient reduction progress towards Action Plan Goals. Established by BIL, the Gulf Hypoxia Program (GHP) is managing and distributing the $60 million in funding over five years.

This presentation will provide background on the Hypoxia Task Force and will highlight current and future work that states, tribes, and partners are implementing under the newly established Gulf Hypoxia Program. Highlights may include projects with climate benefits, multi-state collaborative efforts, innovative tools to track and reduce nutrients, advancement of stakeholder engagement, as well as advancements of state specific Nutrient Reduction Strategies.

Agricultural Success Stories in the CWA 319 Program

Authors: *Addison B Walsh (US EPA)*; Cyd Curtis (US EPA)*

The EPA's nonpoint source program began collecting success stories from states and territories in 2005. These stories highlight water bodies identified by states as being primarily nonpoint source-impaired and having achieved documented water quality improvements. There are over 700 success stories to date from across the country which offer insight into effective and innovative approaches behind each water quality improvement. This presentation will focus specifically on success stories that address agricultural nonpoint source pollution and discuss findings from analyses of the many parameters collected as a part of each success story. This will include an evaluation of pollutants, timeframes from listing to delisting, suites of management/restoration practices, waterbody types, as well partners and funding.

Performance of Ohio Drainage Systems under a Hypothetical Future Climate Scenario

Authors: *Elizabeth R Schwab (Iowa State University)*; Toni Chinchar (The Ohio State University); Ahmed Awad (The Ohio State University); Manal Askar (USDA-ARS); Vinayak Shedekar (Ohio State University)*

Future climate projections for Ohio and the Midwest indicate that winter and spring seasons will be characterized by warmer temperatures and wetter weather, while summers will experience hotter temperatures and more frequent and/or longer dry spells compared to present conditions. A prior study assessing climate change in the Midwest suggested that Ohio's future summer climate may resemble that of current-day Arkansas, while its winters may be similar to those presently experienced in North Carolina. These references to specific states are easy for general audiences to visualize, thus facilitating the communication of climate science. Therefore, to assess the performance of subsurface drainage systems in Ohio under future climate scenarios, we conducted a modeling study replacing long-term (1992–2021) Ohio summer weather data with data from Arkansas and long-term Ohio winter weather data with data from North Carolina. These results were compared to simulation results using long-term Ohio weather records. The DRAINMOD model was used to simulate the daily water budget under subsurface drainage systems installed at two drain spacings (20 ft and 40 ft) in a silt loam soil. Results show that shifting the summer and winter weather patterns currently experienced in Arkansas and North Carolina to Ohio affected soil water availability. Compared to present-day Ohio simulation results, the simulated average annual future number of days with tile drain flow decreased by about 26% and 25.5% and average annual groundwater table levels receded by about 7% and 9% under 20 ft and 40 ft drain depths, respectively. Annual and seasonal trends demonstrate that current drainage system designs will still aid in controlling excess water stress and maintaining trafficable conditions under future climate scenarios. However, practices such as drainage water management and drainage water recycling may be necessary to maximize water use efficiency and sustain future crop production.

Surface Mine Restoration and the Prevailing Total Dissolved Solids Problem in the Central Appalachian Region

Authors: *Amir Hass (West Virginia State University)*; Fernando Rojano (West Virginia State University); Robert Cantrell (West Virginia State University)*

Reclamation and restoration of mountain top removal valley fill coal mining operations (MTR-VF) results in elevated stream water levels of total dissolved solids (TDS), adversely affecting stream water quality and watershed ecosystem ecology and function. An extensive study by the USEPA set specific conductance of 300 µS cm-1 (SC; used as proxy for TDS), as a ecoregion chronic aquatic life benchmark value "…below which 95% of the observations of the genus occur and above which only 5% occur" (EPA/600/R-10/023F, 2011). Albeit expectations of temporal decline of TDS overtime back to pre-mining levels, mounting results shows MTR-VF watershed stream water TDS are failing to decline to below the chronic aquatic life benchmark (300 µS cm-1) or the ecoregion background levels (< 100 µS cm-1), decades after reclamation. To date, no practice exists to ameliorate the

long-term elevated SC problem. In this presentation, we will report results from a paired watershed study, emphasizing the role of retention basins and their remedial impact on MTR-VF headwater stream water TDS. While representing an approach to solve the long-term high SC problem in stream water quality associated with MTR-VF watersheds, the conceptual framework of the practice and its broader applicability will be discussed.

Subject: Climate-Smart Agriculture

Location: Room 202 on Upper Level

Time: 1:30 PM - 3:00 PM

Kentucky Center-Pivot Irrigation a Decade After the 2012 Drought

Authors: *Glynn Beck (Kentucky Geological Survey)*; Lucas Ruckdeschel (University of Kentucky Department of Earth and Environmental Sciences); Brad Lee (University of Kentucky)*

Climate change is expected to increase the variability of weather conditions and frequency of extreme events, including drought conditions. To mitigate risk, many Kentucky row-crop producers have included irrigation in their production systems. Historical aerial photography was used to identify and locate center-pivots throughout Kentucky and geographic information systems software was used to determine the total number of center-pivot irrigated row-crop (corn and soybean) acres in Kentucky. Data from this assessment will provide a baseline inventory of center pivots in Kentucky, can be used to evaluate present agricultural groundwater withdrawals, and can be used to promote the long-term sustainable use of groundwater resources in Kentucky. Center-pivot irrigation was first utilized in Kentucky in the early 1980s and has gradually increased over time. Drought conditions in 2012 led to a record yield loss across western Kentucky leading many growers to install center-pivot irrigation. Between 2010 and 2014, the number of center pivots increased from 177 to 566. Factors leading to this increase were a combination of higher-than-normal corn prices during this time and the severe drought of 2012. By 2022, a decade after the 2012 drought, the total number of center pivots in Kentucky was 730. The total number of center-pivot irrigated row-crop acres is less than three percent of the total harvested row-crop acres. There are three areas in western Kentucky with the densest number of center pivots, the Ohio River Valley (unconsolidated sand and gravel aquifers), the Western Pennyroyal (fractured and karstic limestone aquifers), and the Jackson Purchase Region (unconsolidated sand and gravel aquifers). A summary of the challenges in utilizing center-pivot irrigation in western Kentucky, which includes a case study of a farm in the Western Pennyroyal that utilizes center-pivot irrigation, will be discussed.

Planting Green in Western New York: Enhancing Soil Health and Climate Benefits, But Is It Cost Effective?

Authors: *Aaron Ristow (American Farmland Trust)**

Planting green in the Northeast presents challenges due to the colder climate and shorter growing season, impacting soil health, moisture, and temperature. Unpredictable weather patterns further complicate successful implementation. A management practice for no-till farmers involves letting cover crops grow longer in spring, then planting corn or soybeans just before or after termination (Planting Green). This practice can help manage wet springs and enhance cover crop benefits, addressing issues like soil erosion, nutrient loss, and delays in planting due to excess moisture.

Research into planting green is essential to develop best practices for no-till and cover crop management. Understanding crop needs in western New York allows optimization of planting schedules, crop yield enhancement, and mitigation of climate-related risks. Investing in this research supports local agriculture, contributes to food security, adapts to climate change impacts, and minimizes environmental effects.

To evaluate planting green's performance in western New York, we designed plots measuring nine ecosystem services for three consecutive seasons. Growers determined cover crop treatments: 1) No cover crop (control), 2) cover crop terminated before cash crop planting (pre-plant termination), and 3) cash crop planted into living cover crop (plant green) and terminated. Plots followed a randomized complete block design with four replications.

Results indicate increased biomass from planting green versus conventional termination, suggesting a potential rise in soil organic matter. Later biomass growth in spring leads to drier soil, allowing earlier planting in wet years. The additional biomass provides a mulch effect, managing drier summer conditions and minimizing moisture loss. The mulch also aids in late emergent weed control. Planting green doubles potentially available nitrogen, reducing the need for synthetic fertilizers. Active biomass growth into spring reduces herbicide applications, saving farmers money, reducing field trips, minimizing compaction, and offering off-farm environmental benefits. This will be discussed along with the economic outcomes, analyzed through replicated field trials.

Sustaining Soybean and Corn Production in Tennessee and Georgia Through Integrated Soil Health Management Systems

Authors: *Nutifafa Adotey (University of Tennessee)*; Henry Sintim (University of Georgia); Yangxuan Liu (University of Georgia); Xinhua Yin (University of Georgia); Regina Adotey (University of Tennessee)*

Integrating regenerative agricultural practices in row crop production are expected to improve soil health and crop productivity compared to conventional systems. Farmers can only reap the benefits of this practice by implementing the appropriate management solution on their farms. Field trials were conducted in Tifton Georgia, and Jackson, TN to evaluate the effect of reduced tillage [no-till/strip-till (NT) vs conventional (CT)], poultry litter (PL), and cover crop (CC) in corn, cotton, and soybean production systems. Corn, soybean and cotton trials were set up as a randomized complete block design with 6 treatment combinations including NT; NT+CC; NT+CC+PL; CT; CT+PL; and CT+CC+PL, which were replicated four times. Soil health assessments including water infiltration, penetration resistance, bulk density, plant-available nutrients, organic carbon, organic matter, soil pH, and soil respiration were measured before land preparation. There was no significant impact of treatment combination on yield of irrigated soybean (4,791 – 5,017 kg ha-1). In contrast, there was significant effect on yield of dryland soybean, with the highest yield in the CT (5,571 kg ha-1) treatment which was similar to CT+PL and CT+CC+PL (5,321 – 5,356 kg ha-1). Additive effect of CC and PL on yield was observed in NT plots. On the irrigated cotton field, there was no significant difference between NT (1,500 kg ha-1) and CT (1,512 kg ha-1), with no additive

yield effect of CC and PL for NT or CT. In dryland corn, the CT out-yielded the NT treatments; however, there was no additive yield effect of CC and PL on tillage CT or NT. Crops may respond differently to regenerative agricultural practices, so it's important farmers understand regenerative practices that impact yield and soil health. Our goal is to continue to implement these rigorous trials in order to build knowledge on the various options of regenerative agricultural practices that are available for farmers.

Money for Metal: Advancing Soil Health with Grants for Machinery

Authors: *Danielle Isaacson (Minnesota Department of Agriculture)**

Building soil health is key to facilitating resiliency across working lands in the face of a changing climate. However, soil health practices typically require specialized, expensive equipment that many producers do not own. To meet this challenge, in 2022 the Minnesota Legislature established the Soil Health Financial Assistance Program at the Minnesota Department of Agriculture. This program provides grants to individual producers, groups of producers, and local government units for the purchase of soil health equipment. The program was piloted in 2022 with a $500,000 appropriation resulting in 16 grants to 15 producers and one Soil and Water Conservation District, though the total request of funding from applicants was $6.5 million, 13 times the funding available. The program has since received additional funding from the Legislature, and another Request for Proposals for a total of $2.375 million was released in fall 2023, with applications still exceeding 3½ times the available funding. Learn about this first in the nation program, lessons learned, and the partnerships and advocacy work that made it all happen.

Subject: Conservation Models, Tools, and Technologies

Location: Room 203 on Upper Level

Time: 1:30 PM - 3:00 PM

Combining Multiple Soil Survey Data Sources to Support Conservation in the United States

Authors: *Stephen M Roecker (USDA-NRCS)*; Stephen Roecker (USDA-NRCS)*

The USDA Natural Resources Conservation Service (NRCS) provides conservation solutions to producers across the country. Soil survey information provides the scientific foundation for soil conservation on the land. An inventory and analysis of resources to identify resource concerns are critical components in the conservation planning process. If a resource concern is identified, an assessment is necessary to determine the most appropriate conservation plan. Water quality models are used for assessing degradation concerns such as excess nutrients and sediment and transported pesticides to assist the conservation planning process. Raster-based soil survey products derived using digital soil mapping methods are new products within the United States (US) National Cooperative Soil Survey (NCSS) and therefore have not been tested in resource concern assessment tools used in the conservation planning process. In preliminary work, the combination of soil survey information sources has shown utility in developing raster-based interpretation for management and use. This effort tested the utility of combining existing aggregated soil survey products from the gridded Soil Survey Geographic Database (gSSURGO) with new raster-based continuous soil property predictions from Soil Landscapes of the United States (SOLUS) in a water quality model used for resource assessment in conservation planning. The model included the parameters water table depth and type, taxon group, Hydrologic Soil Group (HSG), K Factor, coarse fragment volume, and slope. The water table parameters and taxon group were derived from gSSURGO and SOLUS was used for coarse fragment volume, HSG, and K factor. Various soil properties and saturated hydraulic conductivity derived from a pedotransfer function were used to calculate HSG. The water quality model was generated for the continental US and demonstrates the utility of multiple NCSS soil survey products to support resource assessment nationwide. Next steps will include vetting the water quality results with conservation planners and exploring how raster-based products can be incorporated into the conservation planning tools they use to support producers throughout the US.

Dynamic Soil Properties: The Future of Data-Driven Conservation Planning Tools

Authors: *Sharon Perrone (USDA-NRCS)**

Understanding the soils that underlie our diverse ecosystems is critical knowledge to conservation stewardship because soil-plant feedback is inherent in most terrestrial ecosystems. While inherent soil properties such as texture and mineralogy limit the types of ecosystems that exist on a landscape, dynamic soil properties (DSPs) – those that change as a result of land use, management, and natural disturbance on a human time scale – can be key indicators of soil and ecological function. The Natural Resources Conservation Service (NRCS) Soil and Plant Science Division is

integrating DSP data collection into the National Cooperative Soil Survey, relying on conservation partnerships to develop meaningful projects. This presentation will cover the NRCS DSP data collection requirements, current progress, and prototype products and will solicit feedback from partners. This presentation is targeted towards land managers, ecologists, soil scientists, and conservation leaders who are interested in situating DSPs in an ecological context and learning about federal efforts to support conservation planning tools.

How Much Tillage Is Too Much? Soil Health Response of Strategic Tillage Management in Semi-Arid Drylands

Authors: *Rajan Ghimire (New Mexico State University)*; Vesh Thapa (University of Nebraska at Lincoln); Wooiklee Paye (USDA ARS)*

No-tillage (NT) is increasingly adopted in climate smart agriculture to improve soil health and sustainability, but soil organic carbon (SOC) and nutrient stratification under long-term NT often limit soil productivity. Targeted strategic disturbance of continuous no-tillage is occasionally practiced to overcome challenges of long-term no-tillage, yet their adoption is limited because of the lack of information on the SOC and nutrient cycling under occasional soil disturbance and policy to support farmers adopting these practices. We evaluated the response of SOC and nitrogen (N) fractions after one strategic minimum tillage operation (i.e., stubble mulch tillage: SMT after six years of NT) in a continuous NT system in semi-arid drylands. Other tillage systems compared include conventional tillage (CT) and strip tillage (ST). The CT, NT, and ST plots were established in 2013, and SMT plots were established with one pass of stubble mulch tillage in 2019 and another pass of disk tillage in 2022 in long-term NT plots. Soil samples were collected from 0-15 and 15-30 cm depth of each plot before SMT 2019 and 2 days, 7 months, 14 months, 19 months, and 26 months after SMT implementation. The CT management resulted in 12-27% and 11-16% lower SOC than under NT, SMT, and ST in 0-15 and 15-30 cm depth, respectively. Similarly, CT and ST had 22-53%, 44-79%, and 43% greater soil inorganic N than NT and SMT after 2 days, 7 months, and 19 months, respectively, in 0-15 cm depth. The 3d-carbon dioxide-carbon (CO2-C) was 32-65%, 48-65%, 62-102%, and 122-195% greater under CT and ST than under NT and SMT after 2-days, 7-months, 19-months, and 26-months, respectively, in 0-15 cm depth. The microbial biomass carbon (MBC) showed varying responses, with 31-64% lower after 2 days and 26 months, while 35-39% greater after 7 months under CT than under NT and SMT. In addition, soil macro-aggregates were 51–54% greater under ST, NT, and OT, while small and micro-aggregates were greater in CT. However, CT had 28–31% less soil aggregate-associated C in large macro-aggregates and 47-53% less in small aggregates at 26 months (M) sampling compared to ST, NT, and OT. The SOC and N fractions did not differ between NT and SMT in most of the samplings. Disk tillage effects in 2022 are still under investigation, which may reveal how often SMT can be utilized in a long-term NT system without negative impacts on soil properties in semi-arid dryland cropping systems. This study showed one stubble mulch tillage after six years of continuous NT did not affect SOC and N storage in 0-30 cm depth. This study provides valuable information to farmers and policymakers, specifically in light of the ongoing discussion on the role of SOC sequestration in climate change

mitigation and the challenges of continuous long-term no-tillage. State and national policies should support the occasional mixing of crop residues and breaking compaction pans in long-term no-tilled farms

Integrated Modelling for Watershed Evaluation of Beneficial Management Practices

Authors: *Wanhong Yang (University of Guelph)*; Yongbo Liu (Environment and Climate Change Canada); Shawn (Hui) Shao (Esri Canada Limited); Zhiqiang Yu (DHI Canada)*

Growing concerns about the adverse environmental effects of agriculture have led to the establishment of various government-led or partnership programs to incentivize farmers to implement agricultural conservation practices or beneficial management practices (BMPs) such as conservation tillage, nutrient management, and riparian and wetland restoration for improving water quality and other benefits. In this presentation I introduce the development of a GIS-based fully distributed hydrologic model, namely Integrated Modelling for Watershed Evaluation of BMPs (IMWEBs), for evaluating the water quality benefits (sediment and nutrient reductions) at site, field, farm, watershed, and river basin scales. The IMWEBs characterizes climate, runoff, sediment, plant growth, and nutrient processes from overland to streams to the watershed out. In addition, the IMWEBs characterizes crop management (such as crop rotation and tillage), manure and nutrient management (such as manure incorporation, manure setback, and catch basin), riparian and surface water management (such as off-site watering and fencing, riparian buffer, and grassed waterway), wintering site management (such as alternating wintering site annually), pasture management (such as rotational grazing) and marginal cropland management (such as conversion to tame and native perennials). The IMWEBs utilizes climate, topography, soil, landuse, land management and other data for setup and uses flow and water quality monitoring data for calibration and validation. The calibrated IMWEBs can be then used to estimate location-specific watershed quality benefits for various BMP scenarios. The IMWEBs has been applied to quantify water quality benefits of existing and future agricultural conservation practices for evaluating agri-environmental program performance and planning further investments on these programs in provinces of Alberta and Ontario in Canada. The IMWEBs needs to be further developed to characterize more BMPs with a user-friendly interface. Conservation researchers and practitioners are welcome to attend the presentation.

Subject: Conservation on the Edge

Location: Room 204 on Upper Level

Time: 1:30 PM - 3:00 PM

Microbial Communities as a Pathway to Improved Woodchip and Corncob 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 emerging edge-of-field technology that hold great promise as an engineered denitrification system. In bioreactors agricultural water interacts with microbial communities from woodchips and corncobs resulting in nitrate removal. Bioreactors are novel technology in that these systems treat nitrate laden water in a small physical area. Although we know that bioreactors are an effective conservation tool, the microbial community responsible for denitrification is largely unexplored. Six upflow columns were designed to represent bioreactors in a controllable environment for monitoring of microbial communities, greenhouse gas production, and water chemistry. Three columns contained a carbon source of woodchips and three contain corncobs and were run for six months at two HRTs (8 hr, 16 hr). Preliminary data shows that at 8 h HRT, corncobs remove 57.45% nitrate whereas woodchips remove 14.11% nitrate; however, corncobs produced more carbon dioxide. The corncobs had a notable initial flush of TOC, potentially causing the carbon dioxide production. Additional trends were observed in ORP, DO, pH, NO3-N, NO2-N, and NH4+ water analysis. Future analysis include analysis of water and media microbial communities relative to explain greenhouse gas production and water chemistry analyses. Further work will determine denitrifying gene presence to assist in developing an optimal performing bioreactor with minimal greenhouse gas production and increased nitrate removal rates.

Operationalizing the Edge-of-Field Roadmap: A Novel Approach to Motivating Marginal Lands Restoration for Carbon, Water Quality, and Biodiversity Benefits

Authors: *Matthew Houser (The Nature Conservancy)*; Amy Jacobs (The Nature Conservancy); Shamitha Keerthi (The Nature Conservancy); Lyndsey Dowell (The Nature Conservancy); Seth Harden (The Nature Conservancy); Eugene Yacobson (The Nature Conservancy); Rachel L King (The Nature Conservancy); Nadia Alsadi (The Nature Conservancy); Michael Dunn (The Nature Conservancy); Kris Johnson (The Nature Conservancy); Josi Sales (The Nature Conservancy); Lowell George (The Nature Conservancy)*

In partnership with SWCS and The Meridian Institute, The Nature Conservancy led the development of an Edge of the Field (EoF) Roadmap in 2021. The roadmap included nine recommendations related to supporting natural habitat restoration and conservation drainage efforts on agricultural lands. TNC is now operationalizing these recommendations through a project in partnership with a

large agri-business company. Our work develops, pilots, and evaluates a "payment for ecosystem services" model to restore natural habitats on marginal lands through adopting EoF practices that provide water quality improvement, carbon sequestration and biodiversity benefits. We are testing this approach in Indiana and the Chesapeake Bay watershed to understand how to effectively accelerate EoF conservation in key United States agricultural regions given place-specific ecological, social, and political factors. This presentation focuses on Phase 1 of the program, a significant investment into ecosystem, spatial, and social science evidence to evaluate and quantify the co-benefits provided by different EoF practices. This assessment is being carried out through a systematic literature review of the ecological benefits of EoF practices, spatial mapping across our key regions to quantify the full opportunity for EoF Practices on marginal lands, and farmer interviews to understand willingness to participate in an EoF ecosystem market. Phase 2 will pilot an EoF payment with farmers based on results from Phase 1. We will discuss our 1) findings of comparative carbon, water quality and biodiversity benefits from a suite of EoF practices, 2) present opportunity maps of potential sites for key EoF practices in both Indiana and the Chesapeake Bay Watershed, and finally, 3) outline some preliminary results on farmers' perspectives and preferences for restoring marginal land with insights into the levels of investment needed through ecosystem markets to catalyze large scale adoption of EoF practices.

Phosphorus and Nitrate Removal by a Wood-Chip Bioreactor Stacked with a Phosphorus Removal Structure at the Field Scale

Authors: *Chad Penn (USDA-ARS)*; Mark Williams (USDA ARS); Manal Askar (USDA-ARS); Jed Stinner (USDA-ARS); Vinayak Shedekar (Ohio State University); Kevin King (USDA-ARS)*

Both nitrogen (N) and phosphorus (P) reductions in agricultural drainage water are necessary for improving water quality. We constructed and monitored a paired woodchip N bioreactor placed up-pipe of a P removal structure, for treating a six-inch tile outlet from a conventionally farmed field. The bioreactor was constructed according to the NRCS standard. The P removal structure was designed using USDA-ARS P-Trap software and contained nearly 2 tons of activated alumina. Although the site did not produce enough dissolved P to warrant construction of a P removal structure and attempts to increase dissolved P losses through creating a soil "hot spot" failed, the P removal structure removed 30% of the 2-yr dissolved P load. The N bioreactor bypassed 93% of flow while the P removal structure treated 100% due to its ability to treat 5.1 L/s. As a result, the P removal structure also removed nearly 10x more N than the bioreactor. A dissolved P "spike test" illustrated how filter media tend to perform better with higher inflow concentrations (0.2 to 2.4 mg/L). Over the nine-day spike test, the filter removed 74% of the cumulative P added, and three times the mass of P than what was removed during natural flow concentrations (mean of 0.037 mg/L), illustrating the need to target P removal structures on P hot spots to achieve maximum return. Both N and P concentrations and loads leaving the field and flowing into the structures were greater for stormflow than baseflow. Altogether, these facts emphasize the need to design both P removal structures and N bioreactors to be able to handle high stormflow rates and volumes.

Tile-Treatment Wetlands: A Confluence of Farming, Natural, and Recreational Landscapes

Authors: *Jill Kostel (The Wetlands Initiative)*; Jean McGuire (The Wetlands Initiative)*

Tile-treatment wetlands typically are located at the intersection of subsurface drainage and land at the edge of row-crop fields, where they provide a natural long-term and effective solution for water quality improvement. However, additional beneficial opportunities for these wetlands can be found where farmland meets recreational land.

To meet state nutrient reduction goals, the adoption of edge-of-field (EoF) practices needs to increase, particularly in areas with subsurface (tile) drainage. Typically, wetlands, saturated buffers, and riparian buffers are located on less profitable farmland acres. The adjacent unfarmable landscape may provide additional locations. The adjacent landowners improve water quality and receive enhanced wildlife habitat and recreational areas. This situation creates a mutually beneficial relationship between hunters/naturalists and farmers, who can have contentious relationships in areas where row-crops are prevalent.

This presentation will focus on two Smart Wetland projects, where we constructed a tile-treatment wetland on land next to the row-crop field. One created wildlife habitat for hunting and dog training, and one provided more passive recreation activities in an urban area. As a result of these projects, two new social-ecological systems were formed by developing 20 acres of wetlands and prairie habitat for wildlife and migratory birds, reducing nitrate loss from 700 acres of tile-drained cropland, creating a small business, and increasing recreation opportunities for central Illinois residents. For both projects, we created a collaborative community of wetland conservation professionals that includes the U.S. Fish and Wildlife Service, Ducks Unlimited, Pheasants Forever, and the Illinois Land Improvement Contractors Association. Case studies and strategies will be presented for conservation outreach professionals and technical experts who implement practices that address water quality and natural habitat resource concerns.

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Location: Room 206 on Upper Level

Time: 1:30 PM - 3:00 PM

Improving Soil Ecosystem Services Through Multidisciplinary Framework That Provides Methods for Native Tree Planting and Grass Bioswales with Fungi Amendments to Increase Sustainability and Phytoremediation

Authors: *Deborah January-Bevers (Houston Wilderness)*; Loren Hopkins (Rice University)*

Through a multi-partner, large-scale targeted native trees and grasses framework, implemented in the Greater Houston Region (Texas, USA), thousands of high-ES ranking tree species, prioritized based on their respective levels of GHG, 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 and/or effects of sea level rise. 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 heavily 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 Program and Riparian Targeted Use of Buyouts (TUBs) Program – providing thousands of targeted large-scale tree species on industrial properties along the 25 miles of the Houston Ship Channel, and prioritizing federally-qualified contiguous buyout properties adjacent to riparian corridors leading to Galveston Bay - providing ecosystem services through large-scale targeted native tree plantings and creation of native grass bioswales on the recovered green spaces. These regional efforts are accompanied with fungi amendments with data analysis to provide baseline improvements in soil ecosystem services. The multidisciplinary framework includes engagement of multisectoral leadership broadened beyond those traditionally working on climate change resilience – including health departments, major energy and gas companies and native tree and grass growers, and community leadership. Aspects of the multidisciplinary framework can also be found in https://doi.org/10.1002/ppp3.10245.

ISAP's Introduction to Soil Health Practices Guidebook: How Featuring Farmers' Experiences Can Elevate Agronomic and Educational Resources

Authors: *Helen VanBeck (American Farmland Trust)*; Rachel Lechuga (American Farmland Trust); Torey Colburn (American Farmland Trust)*

The Illinois Sustainable Ag Partnership's (ISAP) recent publication, "An Introduction to Soil Health," communicates the role of soil health practices in addressing agronomic challenges and resource concerns. The guidebook offers practical agronomic recommendations, management considerations specific to Illinois, and the first-hand experiences of six Illinois farmers who are finding success with conservation cropping systems.

In this session, ISAP Manager Helen VanBeck will share insights on the process of creating this 30-page resource, discuss the role of farmer- and scientific-review teams in the development of the guidebook, and offer lessons learned throughout the timespan of project. Torey Colburn, a co-author of the guidebook and conservation agronomist with American Farmland Trust, will highlight how local scientific research and economic data, as well as his own personal experience working with Illinois farmers, were used to inform the agronomic and technical advice offered in the guidebook. Finally, Rachel Lechuga, program associate with American Farmland Trust, will share ISAP's approach to farmer storytelling, emphasizing how the guidebook fits into a larger suite of communication strategies ISAP uses to share farmer stories, build farmer networks, and celebrate farmer success.

Revamping the ISAP Advanced Soil Health Training's Engagement Strategy to Reach More Conservation Professionals

Authors: *Megan Baskerville (The Nature Conservancy)**

Since 2017, the IL Sustainable Ag Partnership (ISAP) has been implementing its Advanced Soil Health Training, a multi-part training for farmers, advisors, and conservation professionals on soil health principles and pragmatic implementation of the principles in a row crop system. In 2023, ISAP began reevaluating the program's curriculum and outreach strategy to improve application rates and trainee retention for its upcoming 2024 training. With assistance from Rooster Strategy, an Illinois-based communications firm, ISAP is evaluating strategies to communicate the value of the training to its intended audience. This will direct possible re-branding of the program, and direct new strategies to increase the number of applicants for ISAP's 2024 training. The revised engagement strategy will be implemented from March-May 2024. This presentation will highlight the process, assets developed for the application process, and results, including numbers of applicants and their geographic distribution across IL, all compared to previous trainings. Lessons learned for higher engagement should be transferrable to any organization wishing to provide conservation training to farmers, retail crop advisors, or conservation professionals.

Utilizing ACPF Tools to Complement and Catalyze Watershed Conservation Efforts: Learning from Local Examples

Authors: *Adrienne L Marino (The Nature Conservancy)**

The Agricultural Conservation Planning Framework (ACPF) has been used in hundreds of HUC-12 watersheds throughout the U.S. Corn Belt and beyond. However, due to limits in capacity, resources, and institutional support, there are few examples of the tools being used to guide conservation planning efforts in Illinois. This lack of relevant local examples, and the associated lack of technical and outreach experience with ACPF tools and outputs among conservation professionals, are key barriers to achieving widespread use of ACPF in Illinois. To help overcome these barriers, The Nature Conservancy is working with agency and conservation partners to build

capacity to better use ACPF tools in Illinois watersheds, as well as leading local pilot projects to demonstrate the value of ACPF outputs in planning and outreach efforts. This presentation will focus on the application of ACPF tools in Pine Creek Watershed, a sub-watershed of the Lower Rock River Basin, a nitrogen-priority watershed in the Illinois Nutrient Loss Reduction Strategy. In addition to providing local soil and water conservation professionals and watershed leaders with valuable hands-on experience using ACPF outputs, the project team is also working closely with a local stakeholder group to integrate ACPF outputs and other local data on water quality, biodiversity, and recreational values into a landowner engagement strategy that builds awareness of watershed issues and produces increased adoption of conservation practices. To expand the reach of the project, the team is developing a case study to demonstrate how using ACPF tools can complement and catalyze conservation actions in similar agricultural watersheds throughout Illinois.

Subject: Social Sciences Informing Conservation

Location: Room 208 on Upper Level

Time: 1:30 PM - 3:00 PM

"The Hoops and Hassles You Have to Go Through": A Qualitative Analysis of Farmers' Experiences with Incentive Programs Supporting Cover Crop Adoption

Authors: *Maria Teresa Tancredi (University of Georgia)*; Jennifer Thompson (University of Georgia)*

Since 2022, the Inflation Reduction Act and the Partnerships for Climate-Smart Commodities have invested new and increased funding to voluntary programs supporting conservation and the adoption of sustainable practices. While it is encouraging to see concrete investments towards the resilience and sustainability of our agricultural systems, emergent results from a series of interviews conducted with US row-crop farmers revealed conflicting experiences with those programs.

Between February 2022 and March 2023, we conducted semi-structured interviews with over 80 farmers across nine states in the Northeast, Southeast, and Midwest US to investigate their perspectives and experiences with conservation practices, specifically cover crops. During those interviews, farmers' comments on programs supporting cover crop adoption showed a wide range of experiences: from lack of awareness around the programs available to growers, to positive experiences, to critical recollections of the application process and requirements of the programs. In this presentation we will introduce the preliminary results of our qualitative analysis (i.e., thematic analysis conducted using Atlas.ti) and highlight the programs' strengths and issues as identified by the farmers in our research.

As the number of programs and funds available to farmers keeps expanding, it becomes increasingly urgent to continue a critical conversation around incentive programs. Focusing on the accessibility and effectiveness of these programs can help achieve broader enrollment in the programs and enhance their ability to support conservation in the face of climate change. As such, we invite farmers, outreach specialists, and other conservation practitioners to attend our session and provide feedback based on their experience and expertise. Finally, we encourage others to investigate similar topics with both farmers and practitioners in their area, and policy makers to consider the insights provided by social scientists when evaluating the quality and effectiveness of these programs.

Understanding Nutrient Management Decisions: Comparing the Agricultural Community in Indiana from

2014 to 2023

Authors: *Casey Olechnowicz (Purdue University)*; Linda Prokopy (Purdue University)*

Nutrient management is a pressing issue in agriculture nationwide, with renewed calls for regulation and shifts in best management practices due to externalities like the Gulf Hypoxic Zone.

In Indiana, various agricultural sectors collaborated with the NRSS Lab at Purdue University to study nutrient management decision-making over a 10-year period. Statewide surveys conducted in 2014 and 2023 gathered data on farm characteristics, awareness of pollutants, nutrient management best management practices (BMPs) usage, and decision-making factors, including trust in information and information sources. The 2023 survey gathered responses from over 800 landowners and producers in Indiana, and revealed significant changes in demographic and operational aspects of the agricultural community, alongside evolving perceptions of nutrient-related issues. Key findings include a decrease in concern about water quality impairments from pollutants, despite a rise in familiarity and usage of BMPs. The importance placed on nutrient management decision-making has generally decreased, alongside a consistent decline in trust in information sources. These findings highlight the shifting dynamics in nutrient management for Indiana's agricultural sector over nearly a decade. Understanding the root of these changes is crucial for agricultural partners in Indiana to determine effective future outreach or regulatory strategies to address persistent nutrient management issues.

Understanding the Persistence Use of Cover Crops by Agricultural Producers: Evidence from Indiana and Maryland

Authors: *Elsie Assan (Purdue University)*; Linda Prokopy (Purdue University)*

Farmers continue to play a crucial role in addressing agri-environmental problems such as water quality degradation caused by non-point source pollution through their adoption of conservation practices. Existing literature shows that provision of financial and technical assistance to farmers through government-sponsored agri-environmental programs, such the Environmental Quality Incentives Program and the Conservation Security Program, is important for supporting conservation activities and securing conservation gains. Incentives enable farmers to adopt practices earlier than anticipated, expand on existing conservation practices on their farm, and equip them with needed technical knowledge for successful implementation and management of adopted practices. A major assumption of incentivized programs is that program participants will continue the use of conservation practices long after their contracts have ended. However, there is a paucity of evidence showing the extent to which this assumption holds true for agricultural conservation. Consequently, there is a need for studies to examine if farmers continue with conservation practices after they exit conservation programs, what the facilitators of practice persistence are, and if there are any differences in the level of persistence among farmers who persist. Further, there is a need to understand why some farmers discontinue practice use and what constraints influence practice discontinuation, as a lack of conservation practice persistence could erode the conservation gains achieved and potentially worsen the negative impacts of agricultural activities on natural resources. Focusing on cover crops, this study will draw upon semi-structured in-depth interviews with a random sample of 30 farmers who were past participants in either EQIP or CSP in Indiana and Maryland between 2014 -2021 to examine cover crops persistence among farmers in these states. The interview data will be analyzed using thematic analysis to identify what factors inform farmers' cover crops persistence decisions, differences (if any) in cover crop use

among farmers post-program participation, constraints to cover crops persistence, and possible support that could be provided to enable farmers' continued practice adoption. The findings of this study will enable agricultural conservation policy makers, soil and water conservation professionals, and agricultural stakeholders to understand the nuanced nature of conservation practice persistence post-program participation. Further, the findings of the study can help policy makers identify enabling conditions that could be integrated into agri-environmental programs to support practice persistence beyond contract expiration.

Subject: Conservation Models, Tools, and Technologies

Location: Room 202 on Upper Level

Time: 3:30 PM - 5:00 PM

Determining the Spatial and Temporal Distribution of Runoff for Ephemeral Gully Erosion Prediction in Croplands

Authors: *Dalmo A. N. Vieira (USDA - Agricultural Research Service)*; Daniel Yoder (University of Tennessee, Knoxville); Robert Wells (USDA - Agricultural Reserach Service); Ron Bingner (USDA)*

Modeling tools are being developed to estimate soil loss resulting from ephemeral gullies in croplands. These perform dynamic flow and sediment transport calculations to predict where and when gully channels start, and how gully depths and widths increase with successive storms. This requires estimation of the volume, duration, and spatial distribution of runoff from rainfall events that occur under significantly different conditions due to changing weather patterns and vegetation cover, as well as abrupt disturbances caused by tillage, planting, and harvesting.

The RUSLER (RUSLE2-Raster) model utilizes the established RUSLE2 soil erosion science to predict runoff and associated sheet-and-rill erosion for entire fields. Gridded GIS maps describe topography, soil types, and crop management zones. Runoff is determined by RUSLE2 using the SCS Runoff Curve Number Method, adjusted daily based on soil biomass, soil consolidation, vegetative canopy cover, residue cover, and surface roughness. A recently introduced water balance approach within RUSLE2 estimates the effect of antecedent soil moisture on runoff and accounts for seasonal wet and dry periods. It determines a daily runoff correction index based on a given precipitation record and calculated values of evapotranspiration and runoff. The water balance adjustment corrects underprediction of runoff in a wet springtime and overprediction in dry summer and fall seasons. Geoprocessing algorithms within RUSLER determine how runoff accumulates over hillslopes to later concentrate in swales, where flows may have enough energy to detach and transport sediment to sustain the erosion processes that form gullies.

RUSLER modeling creates detailed runoff patterns to correlate gully occurrence and sizes to landscape position and agricultural management. Its runoff and sediment load results are used by physically based predictive models of gully erosion, which in turn will provide a better estimation on the amount of soil that leaves fields into streams and rivers.

This work is part of a new suite of modeling tools being developed at the USDA. As erosion prediction technology evolves, farmers and land managers will have better information about the state of their fields to decide how to optimize their resources to reduce erosion even further, contributing to the nation's economic and environmental sustainability.

Evaluating A Modern-Day Geospatial Nilometer: Leveraging Flood Models and Satellite Imagery to Estimate Potential Flood Risk in Vermont's Agricultural Fields

Authors: *John G Van Hoesen (Vermont NRCS)**

Widespread catastrophic flooding occurred across Vermont on July10-11, 2023. This event was fueled by heavy precipitation, with rainfall amounts ranging from approximately 4 to 9 inches falling over roughly 48 hours. This flooding caused erosion, deposition, and contamination with varying degrees of impact throughout the State. To better understand the impact of this event on Vermont's agricultural community and develop estimates of potential disaster assistance needs, Vermont NRCS leveraged a geospatial workflow that estimated flood risk at the field level.

This workflow incorporated three flood models (Hindast RIFT, ICEYE, and UVM Inundation), 30-meter cropland data obtained from CropScape, and the Farm Service Agency's common land unit (CLU) database, to identify fields and crops with potential flood risk. The outputs from this analysis provided: (1) total FSA tracts and total acreage potentially impacted within each county and (2) total potentially impacted acreage of pasture versus corn and grains. The results of this analysis provided a range of impacts across the State. To evaluate the utility of this workflow for future flood events and inform disaster assistance outreach, the modeled results were compared against two data sources: (1) producers that filed for disaster assistance and (2) segmented polygons depicting NDVI differences derived from pre- and post-flood imagery from Planet labs, which was provide by the University of Vermont's Spatial Analysis lab. The goal was to evaluate which flood models, or combination of models, most accurately identified impacted areas.

Vermont has experienced increased precipitation in all seasons, and specifically an increase in the frequency of extreme precipitation events (NCA5). Climate projections suggest that temperature, precipitation (including winter and spring), and large storms are projected to increase. Therefore, developing a proactive approach for identifying highest risk fields to help Vermont NRCS prioritize conservation education and disaster assistance outreach is a priority. Future efforts will explore developing a flood risk index accessible through an interactive dashboard.

Helping Farmers Recharge Groundwater: Findings from the NRCS On-Farm Recharge Pilot Program

Authors: *Wendy Rash (USDA-NRCS)*; Aysha Massell (Sustainable Conservation)*

The California Sustainable Groundwater Management Act (SGMA) coupled with recent drought and flood conditions have prompted an explosion of interest in using flood waters for groundwater recharge. This practice, known as Flood Managed Aquifer Recharge, or FloodMAR, is a key component in many local Groundwater Sustainability Plans for boosting supplies and bringing groundwater budgets into balance. A study by the Public Policy Institute of California estimated that FloodMAR, implemented on a large scale, could replenish up to 25% of groundwater overdraft in the San Joaquin Valley.

An Interim Conservation Practice Standard for On-Farm Recharge, which is the application of FloodMAR to agricultural lands, was developed by the NRCS in California and approved for evaluation by NRCS National Headquarters in 2020. A pilot program to test the practice standard launched in 2022, with the intent to evaluate the technical performance of the practice as well as its implementation through the financial assistance program Environmental Quality Incentives

Program (EQIP). NRCS and Sustainable Conservation collaborated to design, implement, and evaluate the first year of the pilot program. Products of the pilot program include technical support materials for NRCS conservationists to use when planning on-farm recharge with growers; site selection and project ranking tools; outreach materials; partnerships with water delivery districts; accountability metrics; and monitoring methods. The experiences of this pilot program inform the real-world logistics necessary to realize the potential of on-farm recharge to contribute to groundwater budget solutions.

Results and key lessons from the pilot program will be discussed, as well as next steps for expanding the use of the NRCS On-Farm Recharge Conservation Practice Standard beyond the pilot area. Benefits and challenges of the EQIP model, in which financial and technical assistance for performing on-farm recharge is provided directly to farmers, will be explored.

Quantifying the Impacts of Water Storage Practice Opportunities in the Minnesota River Basin

Authors: *Matt Drewitz (MPCA)*; Maddie Keefer (Tetra Tech)*

The Minnesota River Basin is a 10.8-million-acre watershed that stretches from the headwaters of the Minnesota River in NE South Dakota to the Twin Cities metro area. This basin has been significantly altered hydrologically since the late 1800s to enable modern agricultural systems to thrive and increase productivity. These anthropogenic changes have also resulted in significant loss of wetlands, increased conductivity through the alteration of natural water courses and addition of drainage ditch systems, and significant changes in the water yield and flow rates. These impacts have been intensified by increased rainfall and runoff in recent decades along with significant increases in subsurface tile drainage. The State of Minnesota has identified a need to increase the capacity of water storage within the agricultural reaches of this basin to reduce sediment and nutrient transport, as well as protect critical infrastructure from damages caused by extreme runoff events. The MPCA has partnered with Tetra Tech to undergo a study to develop methods to site critical water storage practices on the landscape using novel geographic information system (GIS) techniques and utilize the Hydrologic Simulation Program Fortran (HSPF) watershed model to predict the relative impacts of practices peak and annual flow reductions. This project has focused on quantifying the impacts of six practice types within 13 different HUC 12 sub-watersheds with the basin, which will then be extrapolated to the HUC 8 scale in 3 different major watersheds. This project builds on the development of the Minnesota Sediment Reduction Strategy (2013) and a preliminary project that quantified the efficacy of water storage BMPs at a general scale in the MN River Basin. This talk will provide an overview of the GIS methods developed, HSPF modeled results by watershed and practice type on annual and peak flow reductions, and some of the challenges associated with siting water storage practices within the current state of the basin.

Subject: Cultivating, Conservation Technical Assistance, Community, and Network

Location: Room 203 on Upper Level

Time: 3:30 PM - 5:00 PM

In Support of Trusted Farm Advisors: Sharing A Decade of Lessons Learned

Authors: *Luke Petersen (The Nature Conservancy)**

Farmers heavily rely on agronomic inputs, services, and advice from ag retailers, coops, private-sector agronomists, and other agribusinesses. Collectively, these "farmer advisors" are among the most trusted sources of information for producers and wield substantial influence in management decisions. Therefore, to achieve the necessary pace and scale of conservation practice adoption essential for addressing our most pressing environmental challenges, farmer advisors must play a significant role in promoting and enabling the successful implementation of these practices among their farmer customers. The increasing demand for regenerative agriculture outcomes is also creating an unprecedented opportunity for agribusinesses to incorporate new revenue streams by providing these services.

The Nature Conservancy (TNC) has worked for over 10 years to support farmer advisors in this critical role by building awareness, providing training, de-risking and facilitating new business opportunities, and creating enabling conditions to accelerate change. TNC recently conducted an internal "Lessons Learned" study to replicate and share successes and challenges, test assumptions, and prioritize future work. Qualitative data collected from surveys and semi-structured interviews was synthesized using a thematic analysis to distill insights from over 100 farmer advisor/adjacent projects implemented over the last decade.

General themes explore the evolving role of farmer advisors in regenerative agriculture, the need to clearly define business opportunities, keys to successful engagement with agribusiness, opportunities to support the industry in Diversity, Equity, and Inclusion efforts, and priorities for future research and investment. This presentation will share key insights from the report with partners and interested stakeholders working toward the common goal of enhancing farmer advisors' role in this space.

The STAR Conservation Program in Washington: A Case Study in Using Stakeholder Engagement to Identify and Adapt New State Tools

Authors: *Lauren M. Quackenbush (Washington State Department of Agriculture)*; Dani Gelardi (Washington State Department of Agriculture)*

In this presentation we describe the Washington State Department of Agriculture's process of engaging stakeholders, mobilizing the legislature, and responding to producer needs by adapting the STAR (Saving Tomorrow's Agriculture Resources) Tool to Washington. We review challenges and milestones and offer insights and lessons learned. This session should be attended by current

and developing STAR affiliates, a growing group of seven states with opportunities in eleven more; and others interested in the STAR program as a conservation tool.

STAR is a field-level conservation evaluation tool and targeted improvement plan, first developed by Illinois producers in 2017. This free and voluntary program allows participants to answer simple, production-specific questions about their rotation, tillage, nutrient applications, and conservation practices. Answers are converted to a score of 1 to 5 STARs.

Because the STAR evaluation relies on the expertise of local researchers, conservation professionals, and farmers, it is highly customizable. Here we cover Washington's process to adapt STAR to our state's unique crop and natural resource concerns. We also detail our plans for a network of Washington technical assistance partners and expanded financial assistance pathways.

WSDA asked the legislature for STAR funding in response to lessons learned after two years of surveys and listening sessions with growers across the state. Washington growers overwhelmingly reported interest in using conservation practices and improving soil health. However, many cited economic barriers to experimenting with new techniques. While state and federal programs often provide one-time or short-term cost share, growers asked WaSHI to supplement start-up support by developing market-based valuation. Financial incentives currently in development in Washington and nationally include private supply chain partners; increased crop insurance subsidies; and improved lending terms on farm loans.

Using Science to Engage Growers: A Case Study from the Washington State of the Soils Assessment

Authors: *Leslie Michel (Washington State Department of Agriculture)*; Dani Gelardi (Washington State Department of Agriculture); Jadey Ryan (Washington State Department of Agriculture); Deirdre Griffen-Lahue (Washington State University)*

This presentation describes how soil sampling and data can be used to foster lasting relationships between technical assistance providers (TAPs), government agencies, and farmers. We highlight challenges, milestones, and best practices from a statewide soil sampling project, for others interested in connecting to their stakeholders through science.

In 2019, the Washington legislature tasked the Washington State Soil Health Initiative (WaSHI)—with documenting our state's soil health. In response, we've sampled nearly 1000 fields from 300 farmers in over 60 crops and land uses. Samples are analyzed for over 30 indicators of soil health. Soils data and accompanying management surveys are intended to support WaSHI in: 1) Assessing baseline soil health; 2) Understanding how management impacts soil health; 3) Developing cheap, easy ways for growers to assess their soil health; and 4) Developing crop-specific soil health tools. However, many other capacity- and community-building outcomes have arisen from this work.

Through the soil survey, WaSHI partnered with over 30 conservation districts and nearly 80 TAPs. TAPs were provided with in-person training, soil sampling protocols, and soil sampling kits, so they could support growers in their region even after the soil survey ends. TAPs reported meeting other

conservation professionals for the first time, having a reason to reach out to new producers, and learning crucial new skills. Importantly, TAPs are provided customized soil health reports for every farmer in their project. Reports compare a farmer's soil health metrics with others in the same crop and region, and are intended to expand education and awareness of soil health, while enabling relationships between TAPs and growers.

Centering Equity: Developing an Inclusive Guidebook for Conservation with Historically Underserved Producers and Communities

Authors: *Clare L Lindahl (Soil and Water Conservation Society)*; Candace Spencer, Meridian Institute*

Historically underserved producers face increased barriers in accessing USDA assistance, and conservation professionals familiar with local needs can provide valuable support. This presentation offers practical insights to contribute to positive conservation practices in historically underserved communities. Attendees will also learn about equitable facilitation methods.

These insights come from a roundtable series, developed and led by Meridian Institute and SWCS, with historically underserved producers, nonprofits, and conservation professionals that informed a guidebook for conservation professionals published in April 2024. The guidebook supports field offices in the US in equitably delivering conservation technical assistance in partnership with historically underserved communities and offers national policy recommendations. SWCS & Meridian Institute plan to extend its reach through a training plan, fostering meaningful improvements in how assistance is delivered nationwide.

This presentation is crucial for those in conservation, agriculture, or environmental advocacy, especially professionals aiming to make USDA assistance more accessible.

Subject: Outreach, Education, and Community Engagement

Location: Room 204 on Upper Level

Time: 3:30 PM - 5:00 PM

Educational Interventions Reduce Residential Outdoor Water Use in College Station, Texas

Authors: *Chundun P Khedun (Clemson University)*; Alan Lewis (Water Management & Hydrological Science, Texas A&M University); Ronald Kaiser (Water Management & Hydrological Science, Texas A&M University)*

Water consumption is dependent on a range of variables: indoor and outdoor water use patterns; lot characteristics; changes in behavior during winter and summer; changes in consumption patterns during normal summers and occasional droughts, etc. Water supply and distribution systems are often pushed to near capacity during exceptionally dry summers when demand, often driven by irrigation (and overirrigation/waste), is highest. Understanding factors that affect irrigation and overirrigation can help utilities design better and targeted interventions to curb down waste. In 2012, the City of College Station, Texas, started a program to educate consumers on their water use patterns and how they can improve outdoor use and limit overwatering. Several interventions were implemented: letters with estimated budget and amount overwatered, a website and an app that provides real-time watering recommendations based on neighborhood rainfall stations, irrigation checkups, workshops, etc. In this study, we discuss how we mined several years of water use data to analyze spatial and temporal trends in water consumption resulting from the implementation of these interventions. We clustered customers based on different characteristics, such as water consumption and landscape area, and assessed changes in consumption pattern over time. We show how the cities was been able to save 660 million gallons of water, which is equivalent to more than 2 months of the city-wide total water use during the winter. Lessons learned from this study can help water utilities conserve water by implementing similar interventions in their service areas.

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 touch points, survey, 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.

The Cedar River Source Water Partnership: Conservation Technical Assistance Delivery Through a USDA-RCPP Public-Private Collaboration

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

At the SWCS 2023 Annual Conference, the City of Cedar Rapids shared an oral presentation that outlined the challenges our city faces related to protecting our drinking water supply from nitrate contamination and provided a high-level overview of our partnership efforts. We received many follow-up questions about the nuts and bolts of our partnership efforts. This year, we propose to return to the SWCS Annual Conference for a deeper dive specifically into our Natural Resources Conservation Service – Regional Conservation Partnership Program (RCPP) collaborative effort, the Cedar River Source Water Partnership. The intended audiences for the presentation include conservation professionals, downstream users of water resources, and technical assistance providers seeking to enhance the social impact of their work.

This presentation will introduce the specific partnerships we have developed to deliver technical assistance at various touchpoints across the agricultural sector. Through the dedicated efforts of 17 RCPP partners with a range of expertise, our areas of conservation technical assistance include:

• Conservation agronomy services embedded in ag retail locations

• Practice implementation technical assistance (cover crops, wetlands, and edge-of-field practices)

• Education efforts geared toward non-operating landowners

• Educational curriculum for high school FFA programs

• Communications and broadcast media

The presentation will expand on the specific activities and methods for conservation technical assistance delivery in each of the areas outlined above and will elaborate on our project management approach.

Of course, no partnership effort is without its growing pains and administrative barriers. The presentation will share some of the challenges we have faced getting the project off the ground, and how we have worked to keep efforts moving forward in a positive manner in close communication with our federal, state, and local partners. We are currently in Year 2 of a five-year project, and are actively adapting to changing conditions and implementation needs. Through a conscientious effort to listen to local stakeholders and farmers, our goal is to recruit a new wave of Iowa's farmers and landowners into the conservation world in order to continue to reduce the environmental impacts of farming on downstream users.

Volunteering for Water Quality: Community Rain Gardens in Action

Authors: *Josh Balk (Iowa DNR)**

Pulling together partners and supportive organizations, a local volunteer rain garden project was piloted in 2016. Since its inception, the program has expanded to train over 325 community members on the purpose of rain gardens, the design process, steps for successful installation, and then volunteer time towards the construction of rain gardens. The benefits of this initiative have been multifaceted including: significantly increase rain garden adoption rates throughout the watershed, substantially reduce cost to landowners by eliminating labor expenses, stretch limited grant dollars further with in-kind match, provide hands-on learning opportunities for volunteers, create feel-good public relation promotions, and strengthen local partnerships. In an effort to help other communities address localized stormwater issues, increase citizen engagement, and open new opportunities for homeowners regardless of their socioeconomic status, this presentation will highlight the benefits, challenges, and process related to this replicable program.

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

Location: Room 206 on Upper Level

Time: 3:30 PM - 5:00 PM

Contribution of Mixed Cover Crops to Carbon Neutral Agriculture and Livestock Forage Gaps

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

Routine removal of carbon (C) via harvest and or grazing in agroecosystems prevents achievement of a net zero C balance. However, the performance of a given system relative to a specified C "neutral" baseline such as a native warm-season southern tall grass prairie (STGP) serves as an indicator of C neutrality. Incorporation of fertilized, rain-fed, cool and warm season, mixed forage cover crops have potential to provide forage and year-round ground cover that may reduce erosion and promote retention of soil organic C (SOC). Research was conducted to compare biomass production of mixed forages to STGP and winter wheat (Triticum aestivum), establish whether roots of mixed forage in no-till systems can enhance C neutrality relative to tilled wheat management, and determine legacy effects of prior land management on SOC stocks. Agroecosystems include: STGP; a continuously tilled winter wheat; and two conservation tillage systems, a long-term (1976-2018) minimal disturbance system planted to continuous winter wheat; and a second minimal disturbance system previously in STGP (~40 yr) prior to conversion to minimal disturbance fertilized cool and warm season forage mixes. The cool season mixes contained 4-to-5 forages with winter wheat comprising the majority (2018-22). As a result, biomass hayed from mixes was comparable to continuous wheat management. Aboveground biomass of warm season forage mixes (2018-22) varied from 1676 to 8064 kg ha-1 (844 to 3629 kg C ha-1) and belowground from 130 to 560 kg ha-1 (59 to 252 kg C ha-1). The STGP above ground biomass ranged from 3494 to 4301 kg ha-1 (1572 to 1935 kg C ha-1) and below ground from 2450 to 2820 kg C ha-1 (1102 to 1269 kg C ha-1). These values indicate that hayed biomass was sufficient to fill a forage gap but below ground C returned from warm season mixes did not result in significant C sequestration. Changes in SOC concentrations before conversion in 2018 and 2022 were restricted to the 0-15-cm depth and were determined by the time an agroecosystem was managed as STGP. USDA is an equal opportunity provider and employer.

Influence of Cover Crops on Nutrient and pH Stratification in a Long-Term No-Till Wheat-Corn-Soybean Rotation

Authors: *Jessica Grunberg (Kansas State University)*; Kraig Roozeboom (Kansas State University); Peter Tomlinson (Kansas State University); Gerard Kluitenberg (Kansas State University)*

Nutrient stratification refers to a non-uniform distribution of nutrients along the soil profile, and it's an expected response to long-term no-till management due to the lack of mechanical soil mixing. This process can lead to a higher concentration of immobile nutrients near the soil surface, such as phosphorus (P), which is a potential contributor to the impairment of surface water quality through agricultural runoff. Long-term studies are conducted to improve the understanding of how nutrient

dynamics in the soil interact with different managements after several years, such as fallow management or nitrogen (N) rate alternatives. This study aimed to characterize the influence of different cover crops and N fertilizer management options on pH and nutrient distribution in the soil profile after 15 years of no-tillage in Manhattan, Kansas. The field experiment consisted of a three-year wheat–corn–soybean rotation, where all phases of the rotation were present every year. Fallow management consisted of four different cover crops (CCs) and double-crop soybean grown after wheat harvest plus a chemical fallow as a control treatment, and the N fertilizer during the corn phase was subsurface banded at 5 rates (0, 40, 80, 160, and 240 lb. ac-1). Soil samples were collected after the 2021 and 2022 corn harvests and divided into five depth increments (0-2, 2-4, 4-6, 6-12, and 12-24 inches). Soil samples were analyzed for pH, available P, total N, and total carbon (C). Additional soil samples were collected to assess soil bulk density at each of the depth increments. Comprehensive quantification of these nutrients' dynamics may improve the understanding of cover crops' effect on soil fertility and provide an opportunity for farmers to optimize fertilizer use strategies, while also reducing environmental impact.

Multi-State, Multi-Seeding Rate Evaluations of Multispecies Cover Crop Mixes and Their Effect on Cover Crop Performance and Soil Health Indicators

Authors: *Laura M Starr (USDA-NRCS)*; Joel Douglas (USDA-NRCS); Bryon Kirwan (USDA-NRCS)*

Cover crops (CC) are a conservation practice that can improve soil health, decrease nitrogen leaching, reduce erosion, and improve water holding capacity in cropping systems. There is interest in increasing the number of species in CC mixes and increasing seeding rates to maximize the benefits and multifunctionality of CC. Research was conducted at NRCS Plant Materials Centers in FL, MD, MO, ND, and WA to investigate the effect and interaction of two, four, and six CC species mixes and 215, 430, 645 seeds per m2 seeding rates over four years using a randomized complete block design with four replicates at each location. There was no treatment effect on soil health indicators, soil organic carbon, total percent soil nitrogen, or permanganate oxidizable carbon compared to the no CC control. The two species mix had a lower CC biomass than other mixes in three or four years in MO and two of three years in WA. Increasing the seeding rate had a variable effect where it both increased and decreased CC biomass and biomass N in certain year/site combinations. An economic analysis revealed over a 260% increase in cost to plant four or six species mixes compared to a two species grass/legume mix. No species mix or seeding rate improved CC biomass, CC tissue N, or soil health indicators consistently. The lack of consistent benefits from additional species and/or increased seeding rate suggests that cover crop planning should include a discussion on weighing benefit expectations versus cost.

Variation of Organic and Inorganic Carbon Stocks with Depth and Slope under Three Land Management Systems in North-Central South Dakota

Authors: *Larry J Cihacek (North Dakota State University)**

Carbon (C) is stored in soils as organic carbon (SOC) and inorganic carbon (SIC). Most research focuses on SOC which is widely accepted as a repository for soil sequestered C. However, the role of SIC (lithogenic and pedogenic carbonates) is often ignored and research focused on it as an important repository of sequestered C is generally neglected. A study was conducted on a north-central South Dakota landscape to determine the SOC and SIC differences due to land management while investigating the variation of depth to carbonate concretions in three different land management systems. Three replicate cores were collected to a depth of 1 m, where possible, on a transect from a wetland border to an interfluve position at a 10-meter spacing for each land management. 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. Carbonate concretions were collected separately during the processing of the soil cores and weighed before soil grinding. Soil total carbon (STC), SOC, and SIC of both soil and carbonate concretions were measured separately using a carbon analyzer. Statistical analysis was performed by a three-way interaction between land management, depth, and slope position on the amount of stored C. In general, SIC accumulates in the mid-depths of the soil profile while SOC is highest in the surface soil zone. The contribution of carbonate concretions to STC, SOC, and SIC as well as the importance of SIC's role in evaluating C sequestration in lower rainfall areas of the US Great Plains.

Subject: Water Resource Assessment and Management

Location: Room 208 on Upper Level

Time: 3:30 PM - 5:00 PM

Coordinated Collaborative Partnerships in Western Water

Authors: *Angela Brown (AWWA)**

The right to utilize water has historically been a point of contention, competition, and mistrust in the Western U.S. In the midst of this hyper-competition over water rights in the West, two joint-decision making water management partnerships formed. Much research has been conducted on the formation of partnerships with multiple centers of decision-making (polycentricity) but not necessarily on the formation of joint decision-making partnerships. Utilizing frameworks developed by Elinor Ostrom, this comparative case study examines how these partnerships formed in the midst of competition over water and whether they exhibit characteristics of lasting partnerships. The results of this research showed factors that drove these partnerships forward included Feasible improvement of resource conditions, Salience of the resource, and Common understanding of how these users' actions in the CPR affected one another. Furthermore, the influence of cost and the largest user in the CPR's emerged as a common theme, supporting that those with the most assets and political influence can promote or impede self-organization. Analysis also demonstrated that the partnerships exhibit characteristics of enduring collaborations, primarily Nested Enterprises and Collective Choice Arrangements. This presentation will help those considering inter-agency water management partnerships to determine whether a partnership is feasible, and better understand what attributes of the users and resource are conducive to pursuing partnership.

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 revised and updated the 2013 guidelines to better integrate equity and climate resilience within the NPS program. The guidelines will be finalized in spring of 2024.

This presentation will provide:

• An overview of key barriers identified through listening sessions and the relevant updates to the guidelines.

• Trends in actions taken by states in response to the new flexibilities.

• Expectations for 9-element watershed plans, long term monitoring, and addressing emerging challenges from climate change impacts on local watersheds.

(EPA expects the revised guidelines to be finalized before in Spring of 2024)

References:

Current 319 Grant Guidelines: https://www.epa.gov/nps/cwa-ss319-grant-current-guidance

• 2013 Guidelines: https://www.epa.gov/sites/default/files/2015-09/documents/319-guidelines-fy14.pdf

2023 Guidelines Draft for Public Comment: https://www.epa.gov/system/files/documents/2023-10/draft-revision-for-public-comment_319-grant-guidelines-for-states-and-territories_508.pdf

Actions in FY23 to Increase Equity and Environmental Justice in the NPS Program: https://www.epa.gov/system/files/documents/2022-09/Fall2022-equity-in-the-NPS-program-section-319%20_Final_signed.pdf

Scalability of a Public-Private Partnership to Target Phosphorus Load Reductions from Legacy-Phosphorus Fields

Authors: *Michael Brooker (Ohio State University)*; Jay Martin (Ohio State University); Nathan Stoltzfus (Ohio State University); Sam Francis (Ohio State University)*

Phosphorus (P) loads from agricultural sources are a key contributor to the recurrent harmful algal blooms (HABs) in many freshwater systems including Lake Erie. The dissolved reactive P (DRP) pool is especially concerning as it represents the bioavailable portion of this nutrient. Treating the critical source areas of P, and the dissolved form in particular, is expected to accelerate policy goals set to achieve a 40% reduction of all P to the western Lake Erie basin. Through a public-private partnership with agricultural producers and farmers, we were able to recruit 11 legacy-P fields for a study to quantify edge-of-field DRP loads and reductions achieved by best management practices. We compared the load and concentration data from these sites to other fields monitored through the USDA-ARS SDRU's edge-of-field network in the region. Additionally, sites received management practices that were evaluated for their effectiveness in treating total and dissolved reactive P. We identified greater DRP concentrations and likely greater subsurface loads associated with legacy-P fields. Generally, subsurface loads from legacy-P fields were 2-fold greater, with some fields having particularly elevated concentrations of DRP. Data on the reduction achieved by drainage water management and wetlands is ongoing, but the use of phosphorus removal structures (PRS) have demonstrated the ability to achieve 40% reductions that meet current

watershed targets set for the western Lake Erie basin. In general, the PRS functioned as designed, declining with cumulative P loads, though starting at lower removal rates than expected. This infers that the lifetime of these systems will be shorted than intended. Our analysis has proceeded to evaluate their performance under high and low flow conditions to determine how hydrology affects the ability of PRS to remove DRP. Combining information about the distribution of legacy-P fields, their potential to release P based on the measured data, farmer willingness to adopt practices, and the effectiveness of PRS, we developed a Monte Carlo simulation to answer questions about the scalability of the public-private partnership to make progress towards meeting the water quality goals set for Lake Erie.

USFS-NRCS Soil Water Partnership: A Joint Federal Effort to Assess and Monitor the Soil Hydroclimate in Forested Watersheds Across the United States

Authors: *Amanda Pennino (NRCS)*; Carlos Quintero (USFS); Skye Wills (USDA-NRCS); Stephanie Connolly (USFS); Erin Rooney (NRCS); Dylan Beaudette (NRCS)*

Quantifying soil water dynamics is crucial for understanding rates of and changes to ecosystem processes (e.g., nutrient uptake, soil respiration, stream export). Using spatial data to make accurate, high-resolution spatiotemporal measurements of soil moisture in forested regions results in several challenges, including interferences from dense vegetation and the inability to make measurements at various soil depths. Therefore, in situ moisture monitoring within soil profiles and across forested landscapes is still highly desirable. In 2022, the NRCS and USFS entered a federal working partnership to instrument and monitor multiple experimental forests along the east coast and in the southwest, US, for the measurements of soil volumetric water content, matric potential, and temperature at various depths. The goal of this partnership is to produce spatially distributed, long-term datasets of soil moisture across individual watersheds. Data will be used to support Dynamic Soil Survey efforts to inform and develop products conveying the dynamics of the soil hydroclimate, such as in soil and ecological inventories, soil mapping, and state and transition models. Additionally, these datasets will aid in the extrapolation of point measurements to landscape scale non-static maps. We intend to share primary results from predictive moisture modeling using these datasets. In addition, we will highlight ongoing and future research projects within these experimental watersheds that will utilize these rapidly expanding soil moisture datasets. By establishing relationships between soil moisture dynamics with soil and landscape properties, meaningful predictions of the resilience of forested ecosystems to change can be quantified and used to inform water resource management.

WEDNESDAY, JULY 24

ORAL PRESENTATION DESCRIPTIONS AND AGENDA

Subject: Conservation Economics and Policy

Location: Room 202 on Upper Level

Time: 8:30 AM - 10:00 AM

How Will Soil Health Practices Impact Your Bottom Line: AFT's Predictive Soil Health Economic Calculator

Authors: *Chellie Maples (American Farmland Trust)*; Meng Li (American Farmland Trust); Michelle Perez (American Farmland Trust); Ben Wiercinski (American Farmland Trust); Aysha K Tapp Ross (American Farmland Trust); Bonnie McGill (American Farmland Trust); Jen Tillman (American Farmland Trust)*

American Farmland Trust, through a Cooperative Agreement with NRCS, is creating an Excel-based Predictive Soil Health Economic Calculator (P-SHEC) Tool to aid producer decision-making about use soil health practices in rain-fed, row crop production systems. Farmers are increasingly curious about the effect that improving the health of their soil may have on their overall farm finances. The P -SHEC decision support tool will better inform farmers that are considering adopting soil health practices about the potential benefits for their bottom line. The calculator can be used to estimate the costs and benefits of different soil health practices, such as cover crops, tillage, and nutrient management in rain-fed corn-soybean, and corn-soybean-wheat systems.

AFT used county-level data from gSSURGO and the National Agricultural Statistical Service and developed a machine-learning model to estimate the quantitative relationship between soil organic matter (SOM) and yield. These data are housed within the Excel-based tool alongside COMET Planner data, which estimates the increase in SOM from common soil health practices.

The tool generates 10-year costs and benefits predictions for the effect that increased SOM may have on corn, soybean, and wheat yield as well as increased resilience to drought due to the implementation of soil health practices. Outcomes from the tool can be used by conservation professionals to answer questions regarding the costs and benefits of conservation practice adoption and develop conservation plans and programs that are tailored to the specific needs and goals of their farmer clients.

We look forward to discussing with the audience the modelling methods of the tool, how to navigate through the tool, and findings from our pilot process. We look forward to audience insight on our plans to get the tool into the hands of farmers and conservation professionals as well as future uses of these data.

Lessons Learned from Four Years of Project Implementation in Ecosystem Services Markets

Authors: *Laura Shutack (ESMC); Thayer Tomlinson (ESMC)**

ESMC is a national non-profit, member-based organization. In 2022, ESMC launched Eco-Harvest, a national scale ecosystem services market program for agriculture after conducting three years of pilot programs. Eco-Harvest pays farmers for quantified, verified, and outcomes-based Scope 3 Impact Units for greenhouse gases as well as outcomes for soil carbon, water quality and biodiversity generated from regenerative agricultural practices.

Since 2020, ESMC has implemented projects to test the overall Eco-Harvest program details – including soil sampling, MMRV (measurement, monitoring, reporting, and verification) system development, training materials, and producer support. With four years of in-field project implementation completed, ESMC continues to grow program offerings available to producers including eligible practices, program regions, and crop types.

This session will highlight four years of lessons learned from working with producers in a range of production systems and geographies. It will cover what has worked well and where ESMC has had challenges. Additionally, this session will provide clarity on what producers (and those working with producers) should know when deciding whether to enroll in carbon market programs and how to determine eligibility.

The Economic Benefits of Integrating Land and Water Protection

Authors: *Xiangping Liu (Texas State University)*; Nia Conway (BASF)*

What happens on land ends up in water. Land protection and sustainable land use policies can improve water quantity and quality. Undeveloped land with vegetation slows water flow and reduces run-off, reducing soil erosion and the runoff of nutrients into surface waters and helping replenish groundwater through increased infiltration. In this study, we evaluate the economic benefits of integrating land and water protection using hedonic analysis on residential property transaction data, land parcel boundary data, and land protection and water data from public sources. Our data is comprised of 323,088 single family home transactions in Minnesota and includes information on the distance of a house to water body, size of the nearby water, travel time of a home to the nearest major city, housing characters (age of the house, square footage, number of rooms etc), topography, local social economic conditions (median income, education etc.). The joint effect of land and water protection is measured by an interaction of the proximity of a home to water and to protect land. We use a model specification of continuous distance measures and a specification of discrete radius dummy variables. Our preliminary results show that land and water protection have a stronger statistically significant impact on the price of houses near both lakes and rivers. However, the stronger impact is on lake than river. There is a statistically significant increase in residential property value with water and protected land integration for lakes larger than or equal to 4 ha. Overall, integrating water and land protection is associated with 41.4% higher property values for houses with at least 20% nearby land being protected. Our study helps quantify the

contribution from joint land and water protection effort to the low tax revenues and facilitate decision making on conservation effort allocation. Further study will be undertaken that links water quality indicators with land protection and to expand the study to other regions or states for which we have data.

Subject: Cultivating Conservation Technical Assistance, Community, and Network

Location: Room 204 on Upper Level

Time: 8:30 AM - 10:00 AM

Long-Term Impacts of Tillage Management on Soil Physical Health in Three Geographic Regions in North Carolina

Authors: *Alam Ramirez Reyes (North Carolina State University)*; Ekrem Ozlu (North Carolina State University); Jalynne Ward (North Carolina State University)*

Tillage, while offering advantages through incorporation of crop residues, manure, and fertilizer and alleviating shallow compaction, can also have detrimental effects on the soil, including the destruction of aggregates, formation of hard pans, and reduced organic matter, with regional variation sin the soil's response to tillage. This research evaluates the impact of tillage on water characteristics, soil bulk density, and crop yield in different regions of North Carolina (mountain, piedmont, and coastal plain). This study was performed at three long term tillage trials, in the mountain region at Mills River (30 years old), the piedmont region at Reidsville (40 years old), and in the coastal plain region at Goldsboro (25 years old) that compare no-till to more intense tillage managements. Experimental design was randomized complete block design. Soil samples were collected in 5 cm increments to a depth of 30 cm and analyzed for bulk density and water retention curves. In the coastal plain region, tillage had no effect on soil physical properties. With weak soil structure soil physical properties were primarily dependent on soil texture, which was not affected by tillage. Tillage is a valuable tool for growers to manage their soil; however, it is important to understand type, aggressiveness and the effects of tillage managements in different regions.

Scaling Local Cover Crop Experience to Midwest Success

Authors: *Anna L Morrow (Midwest Cover Crops Council)**

A diverse group of experts provide input to farmers on conservation practices and other management decisions. These experts include industry, university extension, government, and non-profit professionals. In many cases, professionals who provide cover crop recommendations to farmers deliver conflicting information. The misalignment of cover crop recommendations is often all it takes to stall practice adoption. Conservation practices are more likely to be adopted when recommendations from these experts align. Accelerating sustainability requires the slow, steady work of building consensus among partners.

The Midwest Cover Crops Council (MCCC) has worked to build consensus recommendations from diverse partners over the last 18 years, incorporating research and field experience. The MCCC has a commitment to research based, conservative recommendations across 12 Midwestern states and 2 Canadian Provinces. Our resources are a reliable standard for advisors and farmers alike, built by university experts, conservation practitioners, industry professionals, and farmers. The MCCC strives to build general tools and recommendations at a regional level, and refine these resources to

be useful at a local level. As the MCCC grows along with the demand for cover crop recommendations, we are excited to offer in-person trainings and additional resources.

This session is targeted to those working to cultivate a local conservation community and looking for cover crop resources.

The MCCC will present their cover crop recipes, intended to provide a starting point for farmers who are new to growing cover crops; cover crop selector tool, providing seeding dates specific to county climate norms; in-person trainings, tailored to farm advisors; and up-coming virtual cover crop pilot course. Join the MCCC in this session to interact with MCCC resources, learn the methods behind their development, discover how to become involved with new projects, and the MCCC network.

Soil Security: The Missing Piece in the Global Quest for Sustainability and Resilience

Authors: *David O Yawson (The University of the West Indies)**

Soil security refers to safeguarding and improving the quality, quantity, and functionality of soil stocks from critical and pervasive threats to guarantee their availability, access, and utilization to sustainably generate productive goods and ecosystem services. Soils underpin terrestrial primary production and ecosystem services. The quality and quantity of soil stocks are intricately connected with the environmental and socio-economic challenges that threaten life on Earth. These challenges relate to the sustainable supply of water, energy, food, and biodiversity, as well as biophysical challenges such as climate change. As a result, soil security would enhance the sustainable management of terrestrial ecosystems and related services. Poor attention to soil security is one of the strongest weak links in the chain of ideas and actions on sustainable development. To this end, this paper promotes the idea that soil security is critical and should be central to at-scale sustainable development. The paper draws on human security concepts to identify and discuss pervasive and critical threats, as well as the dimensions of soil security that should be prioritized to address sustainable development goals. It draws from the awareness of soil security among graduate students of environmental and natural resources management in the Caribbean and discusses focal conceptual issues. The paper concludes with thoughts on strategies and approaches for mainstreaming soil security in sustainable and resilient development.

The Flow of Development

Authors: *Heather Manzo (Allegheny County Conservation District)**

Conservation Districts with NPDES permit programs have unique longitudinal data related to those permits, including development patterns and location of stormwater control measures (SCMs). ACCD has created open-source datasets and mapped NPDES permit applications and locations of stormwater control measures (SCMs) in Allegheny County. This has replicability in other geographies.

Stakeholder benefits:

- Local governments: ID areas with flooding, landslides, SCM's maintenance and watershed planning.

- NGOs: coordinate where to deploy technical assistance.

- Conservation Districts: stakeholder outreach, data centric program management, and shifting knowledge of stakeholders to watershed scale.

- Watershed groups: ordinance and code updates that protect and improve natural infrastructure.

Stormwater Management Controls (SCMs) were digitized, imported into the Practice Keeper platform. The spatial geometry and relevant data metrics were exported for internal analysis and public data hosting. Municipal development trends were analyzed by overlaying the datasets with municipal boundaries and summarizing the total development acreage within each municipality. Each municipality's cumulative development acreage was then divided by the area of the municipality to obtain a unit of development acres per square mile. Normalizing the data in this way allows for trend comparison across municipalities of varying sizes. Development rates were then categorized into five groups using the Jenks Method and municipalities were mapped and symbolized by graduating color to display municipal-scale development trends throughout the county. This method was again performed using HUC-12 watershed boundaries instead of municipal boundaries, to show watershed-scale development trends. A similar method was used to show SCM distribution on a municipal and watershed scale, the difference being that a unit of "total number of SCMs per square mile" was used instead of cumulative acreage.

Subject: Social Sciences Informing Conservation

Location: Room 206 on Upper Level

Time: 8:30 AM - 10:00 AM

Farmers' Perception about the Sustainability of Agriculture in Chesapeake Bay Watershed's Urbanized Landscapes

Authors: *PARMVEER SINGH (The Pennsylvania State University); Anil K Kumar Chaudhary (The Pennsylvania State University)*; Edem Avemegah (Utah State University); Jessica Schad (Utah State University)*

The rising population, pollution increase, expansion in the size of cities, and shift in land use need immediate attention for the economic and environmental sustainability of agriculture in the urbanized landscapes (i.e., agriculture that is happening on the fringes of the metropolitan and non-metropolitan counties) of the Chesapeake Bay Watershed (CBW). Therefore, the perspectives of stakeholders who are directly affected by changes need to be studied. For this, our research understood the farming community's perception of agricultural sustainability (RQ1) and actions needed to sustain agriculture in the next two decades in urbanized landscapes of CBW (RQ2). The data were collected through a survey using a random sample of crops, and livestock producers within CBW. We received a response rate of 16.2% from 2403 producers we contacted. The findings revealed that 52.50 % (N = 333) of the respondents neither agreed nor disagreed with integrating crops and livestock in a single production system. Moreover, one-third of the respondents (N = 333) agreed that farming operations should rely more on renewable resources. The results also revealed that more than half of the respondents agreed that conservation of soil and water (53.87%, N =336), balance of farming and nature (55.49%, N=337), maximization of the productivity, efficiency, and profitability of farms as a primary goal (56.89%, N = 334), and protection of the natural resources for the next generations (58.33%, N = 336) can help in achieving agricultural sustainability in the urbanized landscapes. The farmers also responded that the application of livestock manure has the potential to enhance soil fertility (54.14%, N =338) and new technologies need to be used to enhance agricultural production (N = 51.79%, N = 336). Additionally, the qualitative analysis indicated 10 research themes such as population growth control, understanding the differences between rural and urban areas, and achieving a balance between farming and development could contribute to supporting and sustaining agriculture in urbanized landscapes. Furthermore, making policies that support and encourage participation in efforts that aim to create better futures was also discussed. Thus, the study has implications for conservation professionals in designing educational programs for producers, youth, urbanites, and the broader public to enhance the sustainability of agriculture in the CBW. Based on research findings, the collaboration between researchers, conservation professionals, producers, and the public may also contribute to co-producing ways to promote agricultural sustainability and the overall quality of the Chesapeake Bay Watershed. To meet the food needs of the increasing population and development initiatives, the conservation professionals engaged in the Chesapeake Bay Watershed and all across the United States would benefit from perceptions collected at the base level in this study.

Social Science Meets Soil Health: An Education and Outreach Approach for Landowners

Authors: *Catherine DeLong (Iowa State University Extension and Outreach)*; Suraj Upadhaya (Kentucky State University); Julia Baker (Iowa State University Extension and Outreach)*

In Iowa, 58% of farmland is leased. Landowners play a key role, whether positive or negative, on the decision to use conservation practices. Those who own the land, but do not farm it, have varying levels of engagement with its natural resources, multifaceted motivations for owning the land, and increasingly complex ownership and decision-making structures. Yet, we often deploy conservation outreach with the assumption that landowners share the same set of knowledge, values and challenges.

In 2023, Iowa State University Extension and Outreach and Polk County Public Works launched an education program that sorts landowners into cohorts based on their awareness, attitudes, beliefs, and perceived motivations and barriers to conservation practice adoption. This approach builds on previous work to adapt conservation messaging based on farmer typology (Upadhaya, Arbuckle, & Schulte 2021; 2023). Each cohort will attend six educational events between June and August focused on conservation practices, leasing and taxation implications, as well as communication strategies for the key influencers in their life (family members, tenants, bankers, etc.). This approach seeks to adapt educational messaging to landowners' unique needs, address each step of the conservation adoption decision-making process, strategically use the time of both landowners and educators, and employ peer-learning techniques.

This presentation will outline the development of the landowner survey, methodology for distributing landowners into learning cohorts and adapting educational events, and implications for future conservation outreach.

Overcoming Barriers to Farm Conservation Practice Adoption: Formalizing an Adaptive, Science-Based Approach in the Chesapeake Bay Watershed

Authors: *Kristin Fisher (The Nature Conservancy)*; Matthew Houser (The Nature Conservancy); David Martin (The Nature Conservancy)*

Nutrient loss from agricultural systems contributes significantly to degraded water quality, biodiversity loss, and climate change. The widespread use of conservation management practices can reduce farm impacts on the environment, but farmer decision-making is a key factor shaping the advancement of these conservation efforts. In the United States, conservation social science research has identified motivators and barriers to farmer practice adoption, but what has been far less studied is how to leverage these insights to more effectively enable farmers to change their management decisions. There is a growing recognition of the need to develop and test behavioral intervention mechanisms through pilot studies to better understand how to make environmental progress broadly and within agricultural systems specifically. Here, we offer insight into The Nature Conservancy's effort to formalize a durable, iterative, at-scale approach to implementing farm

conservation, focusing on advancing precision fertilizer management practice adoption in commodity grain systems in the Chesapeake Bay Watershed.

This presentation will illustrate the development and application of an implementation science approach. First, we discuss our use of decision science and adaptive management to formalize key, testable hypotheses to be examined across our pilot programs. By tracking data on farmer outreach and enrollment in programs, we can assess successful incentive mechanisms that can be refined and scaled over time to reach conservation goals. To demonstrate the application of our framework, we discuss two pilot intervention case studies. To conclude, challenges with and future opportunities for this approach are considered. We expect that conservation professionals involved in agricultural work will be interested to learn about this framework and how social and natural sciences can better integrate expertise to both track and achieve environmental, economic, and agronomic outcomes.

Scaling Up Edge-of-Field Conservation Practice Adoption in the Upper Mississippi River Basin: Learning from Success Stories to Improve Our Approach

Authors: *Elizabeth R Schwab (Iowa State University)*; Thomas Isenhart (Iowa State University); Keegan J Kult (Ag Drainage Management Coalition); Clare L Lindahl (Soil and Water Conservation Society); Adrienne L Marino (The Nature Conservancy); Catherine DeLong (Iowa State University Extension and Outreach); John Tyndall (Iowa State University)*

In order to achieve the nutrient load reduction goals outlined by the Hypoxia Action Plan, statewide nutrient reduction strategies note that, in addition to use of in-field management practices, increased adoption of edge-of-field agricultural conservation practices is needed to manage nutrient and sediment losses and improve water quality. These practices must be applied over broader swathes of the landscape, yet implementing such practices at larger scales is challenging: factors that vary from county to county and state to state have necessitated the development of different approaches to meeting water quality goals. Despite these challenges, a number of initiatives have successfully implemented edge-of-field conservation at large scales, including Iowa's "Batch and Build" model and Minnesota's "Turn Key Approach". Both of these models have led to accelerated design and installation of practices such as drainage water management, denitrifying bioreactors, and saturated buffers. Economic efficiencies inherent in these models may also lower the overall costs of project scale implementation. This project seeks to learn from these successful approaches and other conservation delivery models utilized across six states in the Upper Mississippi River Basin. We will identify and speak with key players in the processes to understand both the challenges associated with scaled-up implementation and the factors that have enabled program success. This information will be used to develop process models and generalized implementation guides that can be tailored to local conditions and utilized by conservation professionals to scale up conservation. This presentation will outline the approach taken to catalogue and centralize information about existing delivery models, and will share progress towards developing outcome materials that can aid in facilitating successful at-scale practice delivery across the region to address water quality goals.

Subject: Water Resource Assessment and Management

Location: Room 208 on Upper Level

Time: 8:30 AM - 10:00 AM

Impact of Conservation Practices on Nitrogen Leaching in Artificially Drained Midwestern Mollisols

Authors: *Natalia Rogovska (USDA ARS NLAE)*; Peter O'Brien (USDA-ARS); Robert Malone (USDA-ARS); Bryan Emmett (USDA-ARS); John Kovar (USDA-ARS); Dan Jaynes (USDA-ARS); Thomas Kaspar (USDA-ARS); Peter Kyveryga (Iowa State University)*

Artificial agricultural drainage is an important land management tool widely adopted throughout poorly drained regions like the glaciated Midwest. While beneficial for crop production, tile drainage alters hydrology of the watersheds and promotes nutrient losses, especially nitrate-N, to natural water bodies. A replicated plot experiment was initiated to quantify the effectiveness of conservation practices on reduction of nitrate-N leaching in subsurface tile drains. Maize (Zea mays L.) and soybean (Glycine max L. Merr.) were grown with three different treatments: 1) Control: no-till crop production, 2) RC: no-till with a winter rye (Secale cereale L.) cover crop), and 3) DW: no-till with an in-situ woodchip denitrification wall with trenches excavated parallel to the tile on both sides and filled with woodchips. During a period of 19 years (2002-2020), all three treatments received the same annual N fertilization in maize years split between planting and sidedress application. Nitrogen rates ranged from 168 to 247 kg N/ha, depending on the Late-Spring Soil Nitrate Test. Averaged across the 19 years, the RC and DW treatments reduced N leaching by 59 and 58%, respectively, compared with the Control. Both conservation practices were effective for the duration of the study, and both were affected by annual rainfall. Effectiveness of RC increased in dry years, while effectiveness of DW increased in wet years. The effectiveness of the RC treatment was related to biomass growth during the fallow period between the maize and soybean crops. Overall, treatment and annual precipitation had the greatest effects on annual N loss in drainage. This suggests that the unpredictability of rainfall may make it difficult to consistently reduce nitrate losses in drainage, but it does not diminish the effectiveness of conservation practices in curbing nitrate losses.

Integrating Conservation Practices for Improved Water Quality: A Case Study on Martin County Ditch No. 28 Drainage System Improvement

Authors: *Kyle B Werning (ISG)*; Chuck Brandel (ISG)*

This presentation highlights ISG's recent involvement in the improvement of a Minnesota Public Drainage System, specifically addressing Martin County Ditch No. 28 (CD 28) in Southern Minnesota. Spanning a 3,200-acre watershed primarily dedicated to row crop production, CD 28 discharges into Cedar Creek, which eventually flows into Amber Lake, part of the Fairmont Chain of Lakes. Our analysis of the existing drainage system revealed undersized infrastructure and an eroding open ditch that caused excess sediment and nutrient loading to downstream water bodies.

Recognizing the need for a conservation-minded approach that addresses stakeholder concerns, ISG initiated a project aiming to not only enhance drainage but also reduce pollutant loading to safeguard Amber Lake.

In tandem with the drainage improvement, the project objectives included the reduction of pollutant loading to Amber Lake, designated as a Class 1, Domestic Consumption water sources within the Drinking Water Source Management Area for the City of Fairmont. Concerns over elevated nitrate concentrations and potential harmful algal blooms (HABs) toxins, which can cause illness through skin contact and breathing in or ingesting water droplets, prompted a holistic approach to address water quality concerns.

The project involves the design and construction of a sediment and nutrient treatment train, including an eight-acre nutrient treatment wetland and an 8,000-linear-foot two-stage ditch upstream of Amber Lake. Anticipated outcomes include a reduction of 12,827 pounds/year of nitrate, 463 pounds/year of total phosphorus, and 28.7 tons/year of sediment to Amber Lake and the entire Chain of Lakes. The implementation of these practices supports goals outlined by the Minnesota Department of Health and the Martin County Local Water Plan. In 2021, on behalf of Martin County, ISG applied for a Board of Water and Soil Resources Clean Water Fund grant to fund these practices and secured an $882,000 grant to implement the project. These two practices go above and beyond the statutory required efforts related to adequacy of the outlet and storage and treatment best management practices (BMPs).

The presentation will showcase the project's success as a compelling case study and real-world example of the effective implementation of BMPs, emphasizing collaboration among multiple stakeholders, and demonstrating the potential for positive environmental impact through strategic conservation efforts in rural surface water management.

Precision Subirrigation and Controlled Drainage to Increase Water Productivity, Nutrient Use Efficiency, and Potato Yield in Sandy Soils

Authors: *Judyson de Matos Oliveira (University of Florida)*; Lincoln Zotarelli (University of Florida)*

Most vegetable production areas in Florida use conventional seepage irrigation (SEE) which has low irrigation efficiency requiring large volumes of groundwater to raise the water table level (WTL). Conversely, drain-tile (SDT) irrigation achieves more precise WTL control and uniformity of soil moisture in the rootzone. Proper management of the WTL is still a determinant factor for achieving benefits to water conservation expected from SDT. Automating SDT can optimize WTL management, enhancing soil nutrient and water conservation. This study aimed to assess the influence of automating the SDT system for controlling irrigation/drainage in a tile-drained field to optimize yield, water productivity, and reduce nutrient leaching, comparing it to a nearby SEE irrigated area (benchmark). A field study was established at the UF/IFAS-Hastings Agricultural Extension Center in a sandy soil under SDT and SEE side-by-side. SDT was equipped with an automated (open/close) irrigation/drainage valve remotely monitored and managed using Smart Drainage Website (AgriDrain Corp.); while irrigation/drainage in SEE was conventionally controlled.

Irrigation schedule was adjusted to crop stages using desired WTL. The WTL was remotely monitored, and weather data was recorded onsite. Volume of irrigation/drainage were measured using flowmeters. Nitrate+nitrite and total-phosphorus were determined in water samples collected in two main ditches and in ten observation across the field. In the 2023 spring potato season, the concentrations of total-P and nitrate+nitrite in the water table samples were similar between irrigation systems, averaging below 1.9 mg.L-1 and 22 mg L-1, respectively; while the average of total-P and nitrate+nitrite concentration in the drainage water samples reached up to 1.5 mg.L-1 and 5 mg.L-1 in SEE and SDT. The WTL averages were 0.63±0.16 m in SEE and 0.80±0.11 m for SDT, respectively; however, the total irrigation volume in SEE exceeded that of SDT by 35% and the total drainage volume in SEE was 27% higher than in SDT. Meanwhile, the averages of total yield ranged from 33-39 Mg.ha-1 and 33-43 Mg.ha-1 and the irrigation water productivity was 7.9 kg.m-3 and 12.6 kg.m-3 for SEE and SDT, respectively. These results indicated automated SDT reduced irrigation needs by enhancing drainage control throughout crop growth.

Subject: Climate-Smart Agriculture

Location: Room 202 on Upper Level

Time: 10:30 AM - 12:00 PM

Predicting Greenhouse Gas Emissions in Semi-Arid Cover Cropping Systems Using Machine Learning Approaches

Authors: *Prakriti Bista (NMSU)*; sarbagya R shakya (Eastern new mexico university); Rajan Ghimire (New Mexico State University)*

The agriculture sector has enormous potential to reduce global warming. Conservation practices, including cover cropping, are promoted for their beneficial effects on soil erosion control and soil health, but their greenhouse gas (GHGs) mitigation potential is still debated. This study aims to evaluate different ML techniques and the impact of major drivers: environmental (soil and air temperature, soil moisture content, water input) and crop type (no-cover and mixture of cover crops) affecting GHG emissions under irrigated forage cropping systems in semi-arid western USA. We will use weekly to biweekly GHG data measured from diverse cover crops. The data included ~1600 measurements of CO2 and N2O, representing fallow (without cover crop) and three cover crop treatments (Mix1: grass, legume, and brassica, Mix2: grass and legume, Mix3: grass and brassica) with four replicates over three years. Six machine learning (ML) models, random forest (RF), decision tree (DT), gradient boosting (GB), bagging regressor (BG), KNN regressor (KNN), and XGB Booster (XGB) are evaluated for their efficiency in quantifying GHG emissions. There are some variations in response to these models in CO2 and N2O emissions in different treatments. Evaluating overall performance (high R2 and low RMSE), RF and BG were superior compared to other models, and satisfactorily simulated CO2 and N2O emissions. Among the input variables, air temperature and water input had more influence on CO2 emissions, whereas N2O emission was regulated by soil and air temperature. The outcome of this study demonstrated that supervised ML could be used in designing climate-smart cropping systems using environmental data collection.

Regenerative Agriculture for Improving Productivity, Profitability, and Environmental Security in South Asia

Authors: *Sheetal Sharma (IRRI)*; Ajay Mishra (IRRI)*

Regenerative Agriculture practices have received global recognition for their potential to enhance soil health, reduce greenhouse gas emissions, and sustainability. However, a lack of comprehensive data and evidence has hindered their widespread adoption. To address this gap, a rigorous three-year study was conducted at the International Rice Research Institute South Asia Regional Center's farm in Varanasi, India. The study meticulously compared three main farming treatments, each incorporating varying cropping systems and varieties. Yields of key crops, such as rice, wheat, mustard, potato, and peppermint, exhibited remarkable increases—118.6%, 40.5%, 43.3%, 54.8%, and 6.20%, respectively—compared to conventional methods. This underscores the critical role of crop selection in the success of organic and natural farming systems. The study also examined soil

health indicators over two years of natural farming practices. The results were promising, with notable enhancements observed. Soil organic carbon (SOC) content increased by 0.06%, contributing to the overall improvement of soil health. Water holding capacity (WHC) experienced a growth of 2.30%, indicating improved water retention and enhanced drought resilience. Metagenomic sequencing assessed bacterial and fungal diversity in natural/organic farming. The findings revealed that Firmicutes dominated the bacterial community, while Ascomycota dominated the fungal community. This highlights the potential of natural farming practices to enhance microbial diversity and contribute to a healthier soil ecosystem. The significance of this study lies in its provision of scientific evidence supporting the positive impact of natural farming on soil health, productivity, and sustainability. The emphasis on long-term assessments is crucial for understanding the dynamics of yields in organic and natural farming systems. Additionally, the study underscores the importance of selecting crop varieties tailored to the specific requirements of organic/natural farming practices. These findings contribute substantially to the growing body of knowledge supporting the adoption of nature-based solutions in agriculture for sustainable food production and ecological integrity. Future research endeavours should prioritize long-term studies, focus on developing quality bio-inputs, address supply chain considerations, and engage in capacity-building efforts. This comprehensive approach will be instrumental in promoting the larger-scale implementation of natural farming practices. In summary, this study significantly contributes to advancing the knowledge base supporting the adoption of natural farming. It emphasizes the pivotal role of natural farming in achieving sustainable agriculture. It underscores the need for continued research and implementation efforts to realise the full potential of these practices on a global scale.

Top 10 Things You Wanted to Know About Ag Carbon Markets

Authors: *Michelle Perez (American Farmland Trust)*; Bonnie McGill (American Farmland Trust); Emily Liss (American Farmland Trust); Jean Brokish (American Farmland Trust); Rachel Seman-Varner (American Farmland Trust); Bianca Moebius-Clune (American Farmland Trust)*

Have you been scratching your head with questions about the many emerging ag carbon markets? Wondered how to tell them apart? What farmers have to do to qualify? If any are worth it? We were asking ourselves those questions too! Thus, members of the Climate, Water, Policy, and Midwest teams at American Farmland Trust produced the report, "Top 10 Things You Wanted to Know About Ag Carbon Markets" to bring more clarity to this confusing landscape.

The guidebook is meant for farmers, ag advisors, and conservation professionals and written in a conversational rather than academic tone. Using information from the gray literature, we synthesized research into 10 questions that are either top of mind for farmers or provide background on how agricultural carbon markets work. The guidebook answers logistical questions about participation eligibility, data requirements, and contract duration. It compares offset to inset markets, itemizes 53 climate-smart practices, and gives examples of the many co-benefits of climate smart practices. It offers tips for how farmers might make an ag carbon market work for them by stacking private and public sector payments, and considerations for getting into a market

now versus waiting. The guidebook also explains complicated but critical issues such as additionality and permanence.

We also condensed key insights into a one-page "Highlights" document that could be circulated by ag advisors and conservation professionals at winter workshops and farmer field days to pique interest in the guidebook.

Given the unprecedented resources the U.S. federal government has provided in recent years to promote climate-smart agriculture and the proliferation of corporate sustainability and climate programs, the ag carbon markets could be viewed as the latest set of financial assistance conservation programs for farmers to adopt practices that mitigate climate change. Join this session to learn how ag carbon markets may be able to help your farmers achieve their conservation goals.

Probabilistic Estimates of Drought-Related Yield Losses in the Southeastern US

Authors: *Chundun P Khedun (Clemson University)*; Clement Sohoulande (USDA-ARS Coastal Plain Soil, Water and Plant Conservation Research Center)*

Rainfed agriculture in the Southeastern US is vulnerable to hydrological extremes, especially droughts. The nature of a drought event (duration, severity, intensity, and recurrence interval) has varying impacts on crop yields. Drought characteristics and associated impacts are expected to change as the climate changes, thus threatening crop productivity and in turn local and state economies. Understanding the risks that drought poses to agriculture is a critical step in mitigating the effect of climate change. In this study, we investigate the yield loss due to drought for four cash crops: corn, cotton, peanuts, and soybeans in North Carolina, South Carolina, and Georgia. We use the standardized precipitation and evapotranspiration index (SPEI) to identify drought events in the region. We determined the correlation between SPEI with yield anomaly at the county level and then fitted a suite of copulas to identify the ones that can best model the bivariate relationship between the two variables. Different factors, including climatic, physiologic, and agronomic, may explain drought driven yield losses. Using the best fit copula, we constructed bivariate SPEI-yield loss model for each county and determined the mean yield loss and the conditional yield probability of yield loss for different drought events. We found that yield loss for corn was the highest followed by soybeans while cotton and peanuts were slightly more resistant to the effects of drought. This statistical model can be used for resource planning and management and economic analyses.

Subject: Conservation Models, Tools, and Technologies

Location: Room 204 on Upper Level

Time: 10:30 AM - 12:00 PM

Drought Resilience Calculator: Assessing Soil Health's Impact on Plant Water Availability

Authors: *Kade D Flynn (Soil Health Institute)*; Dianna Bagnall (Soil Health Institute); Christine Molling (Soil Health Institute)*

Crop water stress can pose a huge challenge for farmers. Shifting precipitation patterns and increasing temperatures due to climate change are increasing the frequency and magnitude of droughts. Soil health practices can mitigate the consequences of drought by increasing delivery and retention of water to the soil profile. However, the effects of soil health on the water cycle are complex, and farmer operations are diverse. Therefore, farmers require personalized decision support to understand how soil health can benefit their operation through increased drought resiliency. The Soil Health Institute is developing a web-based decision support tool called the Drought Resilience Calculator (DRC). The DRC relies on pedotransfer functions which relate changes in soil organic carbon (SOC) to changes in available water holding capacity (AWHC), an evapotranspiration model, and publicly available soil and weather datasets. Together, these components help farmers understand how soil health can increase the water available for crops on their operation. Here I present use-cases of the DRC on corn production systems across the United States. These results show that soil health practices benefit crop production by increasing the amount of water available to crops. However, the magnitude of this benefit and the mechanisms by which soil health increases available water, such as through decreased evaporation or increased AWHC, vary from operation-to-operation and year-to-year. These results highlight the importance of decision support tools such as the DRC which can consider multiple effects of soil health on the water cycle and provide locally relevant information to farmers in many different weather scenarios. Because farmers consistently rank water management as a major goal of adopting soil health management systems, the DRC provides a powerful incentive to drive the adoption of soil health management. By impacting plant-available water, soil health management practices that benefit carbon also benefit farm profitability.

Machine Learning for Channel Head Identification: A Landscape Analysis Model with Implications for Erosion Management

Authors: *James Zollweg (SUNY Brockport)**

This presentation introduces a novel approach for locating channel heads by leveraging machine learning techniques upon large environmental data sets. The locations of channel heads, the starting points of streams and channels, are crucial for understanding landscape dynamics, particularly soil erosion. The study utilizes a dataset that includes satellite imagery, digital elevation models (DEMs), and diverse landscape characteristics such as slope, land cover, groundwater characteristics, topographic indices, and stream power estimates. These data form an input space

for a machine learning model implemented in KNIME, a low-code model development environment emphasizing Repeatability, Reproducibility, and Extensibility (RRE). Specifically, the model is structured as a Multilayer Perceptron (MLP), a type of neural network. This MLP is designed to identify channel heads and thereby create a means for quantifying erosion potential. Results from the study demonstrate the MLP model's utility in locating channel heads and offering insights into hydrologic processes, drainage patterns, and erosion risk. Understanding the varied factors that create channel heads, including spring sapping and stream power, contributes to being able to quantify erosion risk. The overall physical process understanding of channel head formation also facilitates the development of actionable insights for the remediation and prevention of soil erosion. Additionally, the model is designed with modifiability in mind, allowing for the easy inclusion of additional parameters as desired. This flexibility enhances the model's adaptability to varying landscape contexts and objectives. In conclusion, this approach, employing an MLP model within KNIME, demonstrates significant promise in quantifying erosion potential as well as suggesting strategies for mitigation.

Intelligent Drone-Based GPR Soil Sub-Surface Moisture Assessment: Measurement Campaign and Data Analysis

Authors: *Seyed Zekavat (Worcester Polytechnic Institute)*; Douglas Petkie (Worcester Polytechnic Institute); Radwin Askari (Michigan Technological University); Majid Moradikia (Worcester Polytechnic Institute); Brian Wilson (Michigan Tech Research Institute)*

Soil rootzone moisture assessment is critical to megafarm optimal irrigation technologies. Here, we leverage Drone based Ground Penetration Radars (GPR) for rootzone moisture measurement of megafarms. The transmitted signals of GPR interact with the subsurface soil channel and create backscattered signals. Thus, the backscattered signal carries the subsurface soil channel moisture signature from which the rootzone moisture can be assessed. As a result, the backscattered signal features can evaluate the subsurface moisture via Machine Learning (ML). Here, we specifically focus on supervised methods that require a benchmark to label the data. This talk presents the measurement campaign conducted for the realization of intelligent GPR. In addition, the talk presents intelligent GPR framework and the progress of the SoilX team (please visit soilx.wpi.edu) of Worcester Polytechnic Institute in the development of: (1) GPR hardware, (2) GPR received signal feature engineering, and (3) the enabling research for the realization of intelligent GPR technology.

Using a Field Scale SWAT+ Model to Investigate the Physical and Social Drivers of the Disproportionality of Nutrient Loading in a Wisconsin Watershed

Authors: *Andrew Hillman (University of Wisconsin-Madison)*; Margaret M Kalcic (University of Wisconsin-Madison); Anita Thompson (University of Wisconsin-Madison); Amber Mase (University of Wisconsin - Madison); Joe Bonnell (Wisconsin Department of Natural Resources); Ken Genskow (University of Wisconsin-Madison)*

Nutrient and sediment pollution from agricultural lands is often disproportionate in nature, meaning that a small portion of the landscape contributes an outsized portion of the pollution. For a given agricultural field, the risk of nutrient loss is governed by the inherent vulnerability of the land and by the management being performed on that land. The overlap of high physical vulnerability to nutrient transport and inappropriate agricultural management is where the majority of pollutants may be originating. For this study, a SWAT+ (Soil and Water Assessment Tool Plus) model was built to investigate disproportionate nutrient loading in the Sinsinawa watershed, a HUC-12 located in the driftless geologic area of southwest Wisconsin and northwest Illinois. The Sinsinawa River drains directly into the Mississippi. This region is characterized by steeper hills and valleys compared to much of the Midwest, USA, as well as karst topography in some locations. The physical vulnerability to nutrient transport is highly variable due to these conditions, and there is also a large variability in farm management, from highly managed rotational grazing to commodity crop production on high slopes, taking place in the watershed. This study models the potential for nutrient loss in this watershed, with the purpose of identifying whether the combination of management and physical vulnerability results in a high level of disproportionality in pollutant loading, as well as which combinations of vulnerability and management result in the most outsized loading.

SWAT+ typically reports outputs of spatially discontinuous hydrologic response units, but for this study, the SWAT+ model was altered to report nutrient loading at the field scale, as this more accurately represents the scale at which farmer behavior is carried out. Management of fields in the model is based on specific responses to a mail farmer survey. A management plan and schedule will be developed based on unique responses to the survey, and these management plans will be instituted on sets of fields in the watershed model that aim to approximate the makeup of the managed land the respondent reported. This will result in simulated management practices that are reflective of local conditions. This novel survey-informed SWAT+ model will be run in multiple simulated scenarios in order to investigate the relative impacts that physical vulnerability and farmer behavior have on both the relative magnitude and disproportionality of nutrient loading in this watershed. Insights into the drivers of and level of disproportionality present in watersheds have ramifications for conservation and water quality policy effectiveness in the United States, as current policies may not adequately address this issue. Management practices and nonpoint source pollution policy should be focused on how to address disproportionate nutrient loss more effectively.

Subject: Outreach, Education, and Community Engagement

Location: Room 206 on Upper Level

Time: 10:30 AM - 12:00 PM

Community Stewardship in Action: Restoring Lake Washington

Authors: *Paul Marston (ISG, Inc.); Julie Blackburn (ISG)**

The quality of the water we consume, play, and travel on, depends on proactive community stewardship. This presentation will showcase the how this mentality has made possible meaningful restoration efforts for Lake Washington in Le Sueur County, Minnesota.

Speakers will describe the cultural and recreational significance of the Lake and how, upon its deterioration due to watershed pollution, landowners were inspired and empowered to advocated for improvements. The importance of, and a strategy for, engaging landowners and community members in creating implementable solutions will be outlined.

The results of the collaboration between landowners, community stakeholders, environmental scientists, and water resource engineers will be detailed, including the successful development of a comprehensive watershed plan that identifies projects and best management practices to improve the Lake's water quality. Using the plan as a roadmap, the Lake Washington Improvement Association is moving forward with improvements that are making a difference for their community. Completed and ongoing plans will be discussed and conclude the session.

Extension Training for Undergraduates: Lessons Learned After Three Years of a Regional Cohort

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 interest in individuals for water management related careers outside of dedicated research. Specific objectives include: (1) Develop skills in undergraduate students that will empower them to succeed as future extension professionals; (2) Build 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 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. This presentation includes lessons learned from the first three cohorts and recommendations for other, similar training programs.

K-State's New and Improved Livestock Watering Handbook and Web Presence

Authors: *Ronald Graber (Kansas State University)**

Why should I be concerned about livestock water quality? In the last few years, many livestock producers have seen the effects of prolonged drought on supplies of quality water for their livestock. In response to these conditions, the K-State Research & Extension (KSRE) publication "Waterers and Watering Systems: A handbook for livestock producers and landowners has been updated and is now available. This handbook has been a popular resource, and its use can be expected to grow. Many new topics have been added to the handbook including wintertime watering, bluegeen algae, and remote water level monitoring. Other sections such as pumps and solar pump systems have been updated and expanded. In addition, an extensive web presence is being established for accessing the handbook along with related videos and photographs. The entire publication can be downloaded as a pdf at the KSRE bookstore, but now handbook content, along with related videos and photos can be explored (https://www.kcare.k-state.edu/pubs/watering_handbook.html) on the Kansas Center for Agricultural Resources and the Environment (KCARE) website.

Attend this presentation to learn more about the updated handbook and new online resources forhelping landowners and/or managers with their livestock watering needs.

Planting Hope Along Kentucky's Waterways and Wetlands: One County's Approach to Conservation Education

Authors: *Perry Thomas (Kentucky Association for Environmental Education)*; Christine Svidal (Oldham County Conservation District); Mason Quiram (Oldham County Conservation District)*

Oldham County lies in the Outer Bluegrass ecoregion of Kentucky and within commuting distance of Metro Louisville. The landscape is a patchwork of rural, suburban, and urban areas. With increasing development pressure, restoring and protecting waterways becomes more important every year. In this presentation we describe how multiple organizations collaborate to engage K - 5 students and their families in exploring shallow water habitats; understanding the importance to wildlife of native riparian woodlands; and taking action to increase the diversity and width of vegetated buffers along lakes, streams, and wetlands.

One key element of our approaches is nurturing hope among participants by considering how ongoing restoration projects across one watershed in the County--Currys Fork--increase the

diversity of wildlife in and around waterways. Field trips focus on a restored stream and wetland. A family tree-planting workshop takes place on the banks of a lake in a local park where invasive species have been removed. Live-willow-stake planting events engage families and lead to interest across the county in using this simple approach to revegetate eroding streambanks and lake shorelines.

In 2023, we adapted a published approach to shoreland education by reversing the order of an interactive demonstration. Rather than taking away habitat elements and learning how their absence causes a decrease in biodiversity, we start by symbolically planting a tree beside a waterway and then using puppets to illustrate how one tree can provide multiple habitat elements. In fall 2023, we piloted this adaptation in an elementary school, adjusting language and concepts for each grade level (K - 5). Teachers provided feedback through a post-visit survey, and we incorporated their input as we prepared the workshop for families at the Conservation District's 2024 Spring Tree-giveaway (March) and the County's Third Annual Lake and Pond Management Field Day (April).

In addition, as Oldham County celebrates its bicentennial in 2024, we encourage families attending conservation events to reflect on land use changes across the County, how those changes have affected waterways and wildlife, and how we can all participate in restoring and protecting aquatic habitat.

Going forward, collaborating organizations plan to design and install a constructed wetland for management of stormwater that currently flows from an elementary school parking lot into the Currys Fork floodplain. We anticipate creating a new curriculum to complement the project.

Collaborators in our conservation efforts include Oldham County Cooperative Extension, Oldham County Conservation District, Oldham County Engineer's Office, Oldham County Health Department, Oldham County History Center, Oldham County Schools, and Yew Dell Botanical Gardens. Partial funding comes from EPA 319(h) grants awarded to OCFC by the Kentucky Division of Water for implementation of the EPA-approved Currys Fork Watershed Plan.

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

Location: Room 208 on Upper Level

Time: 10:30 AM - 12:00 PM

Establishing Alfalfa and Sainfoin Through Intercropping with Sunflower

Authors: *Md Shazzadul Islam (NDSU)**

Escalating soil health, food security and environmental challenges necessitate sustainable agricultural practices. Economic, environmental, and biological pressures underscore the need for innovative farming methods. Intercropping, especially combining alfalfa (Medicago sativa L.) and sainfoin (Onobrychis viciifolia Scop.) with sunflower (Helianthus annuus L.), presents a promising strategy. This approach not only enhances crop productivity but also leverages the deep root systems of alfalfa and sainfoin for nitrate scavenging, thereby reducing nitrate leaching into groundwater. Moreover, their extensive root networks stabilize the soil, significantly reducing erosion. The present study was undertaken to explore the feasibility of establishing alfalfa and sainfoin through intercropping with sunflower, by comparing this method with the conventional cultivation of alfalfa or sainfoin and sunflower grown independently. The implications on cash crop yield offset and the yield of seeded alfalfa or sainfoin in the second year were also investigated. Conducted from May 2023 to 2024 in Hickson and Prosper, ND, USA, the study employed a randomized complete block design with four replicates. The treatments included (1) alfalfa alone, (2) alfalfa intercropped with sunflower at 40 kg N/ha, (3) alfalfa intercropped with sunflower at 80 kg N/ha, (4) sainfoin alone, (5) sainfoin intercropped with sunflower at 40 kg N/ha, (6) sainfoin intercropped with sunflower at 80 kg N/ha, and (7) sunflower alone. The results indicated that intercropping alfalfa with sunflower did not significantly affect the overall grain yields (mean grain yield was 2302 kg/ha) of sunflower or forage, and nutritive value of alfalfa, whereas sainfoin intercropping showed a reduction in forage yields. A notable increase in beneficial insect populations within the plots intercropped with alfalfa and sainfoin was observed, suggesting that these intercrops enhance biodiversity as results of healthy and productive soil. In the upper Midwest, intercropping sunflowers with alfalfa emerges as a promising system to produce alfalfa while concurrently yielding sunflower during their establishment year while reducing soil losses due to erosion.

Evaluation of Biochar as a Soil Amendment in Eastern Arkansas Agricultural Production

Authors: *James M Burke (University of Arkansas)*; Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service); Kristofor Brye (University Of Arkansas); Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service); Brett Cooper (University of Arkansas System Division of Agriculture Cooperative Extension Service)*

Biochar is the charcoal-like product resulting from the pyrolysis of organic materials. Biochar has been documented as having beneficial effects in regards to agricultural production and soil health. In September 2022, the Arkansas Discovery Farms Program (ADF) started investigations into the

effect that soil-incorporated biochar has on soil moisture content, crop yields, bulk density and soil nutrient status. These studies are currently being held at two ADF locations in Dumas and Stuttgart along with a location at the University of Arkansas Division of Agriculture (UADA) research station in Newport. Each location employs a randomized complete block design (RCBD) with three treatments and four replications. Biochar treatments consist of application rates equivalent to 0 (0B), 2,000 (2B) and 4,000 (4B) kilograms per hectare (kg ha-1). Biochar was applied to the soil surface and incorporated during planting. Soil moisture sensors were installed in each plot while connected to data loggers and continuously measured soil moisture content in kilopascals (kPa) at soil depths of 15, 30 and 45 centimeters (cm). Soil nutrient status was determined by collecting soil samples from each plot approximately two weeks before planting while bulk density samples were collected over the winter. Results to date indicate that the 2B treatment is significantly higher in soil moisture content at 15 and 30 cm at Stuttgart while at Newport, the 0B treatment is significantly greater at 15 cm. These differences can be attributed to irrigation regimes as Stuttgart relies heavily on furrow irrigation and Newport depends only on rainfall. Estimated 2023 crop yields at all three ADF sites were insignificant among biochar treatments, illustrating the possibility of additional time for biochar to assimilate in the soil before observing significant yield effects. Supplementary data in 2024 will give additional insight into the effects of biochar on numerous agricultural and soil health parameters.

Microbial Activity in Mined Lands Treated with Amendments and Biofuel Crops

Authors: *Tarik Acevedo (Penn State University)**

The long-term reclamation of strip-mined land requires the establishment of soil microbial communities that mediate nutrient cycling and other soil functions to facilitate plant growth. To that end, we need to consider management strategies that improve soil conditions in addition to providing vegetative cover. In this study, we evaluated the microbial activity in mined land soil that was amended for biofuel crop production and had been abandoned for 10 years after biofuel crops were established, compared to conventionally reclaimed soil. Amendments included industry byproducts like poultry manure, papermill sludge, and spent mushroom compost to fertilize soils for biofuel crop growth. Microbial catabolic activity and functional diversity were assessed by two relatively new soil assessment tools, MicroResp and tea bag decomposition assays, as well as a tea-use efficiency assay we developed. Vegetative biomass was higher in all soils with biofuel crop treatments compared to conventionally reclaimed soils. Amending soil with poultry manure and papermill sludge showed the highest microbial multiple substrate-induced respiration (MSIR) and decomposition activity, while conventional reclamation had the lowest. In addition, conventionally reclaimed soils and soils amended with spent mushroom compost showed the highest tea-use efficiency and functional diversity, respectively. Soil quality, as measured by labile organic carbon, total C, and total N, showed few differences between management strategies. The present work demonstrates how a post-reclamation management strategy with amendments and biofuel crops can maintain comparatively high amounts of vegetative cover while increasing microbial activity and functional diversity. Our work also showed that tools such as MicroResp, tea bag

decomposition, and tea-use efficiency assays can be utilized to evaluate how soil management strategies can affect microbial activity and create favorable environments for microbial communities.

POSTER PRESENTATIONS

Cover crops for use as forage: What do we know about tradeoffs with ecosystem services?

Authors: *Jose G Franco (USDA ARS Dairy Forage Research Center)*; Emily J Diaz Vallejo (Dairy Forage Research Center USDA-ARS); Jessica Gambel (USDA ARS Dairy Forage Research Center); Alison Duff (USDA ARS Dairy Forage Research Center)*

Overwintering cover crops can provide ground cover at a time when soils are vulnerable to erosion and nutrient losses, particularly in dairy forage production systems where fall manure applications are common. Winter cereal rye is a resilient, winter-hardy species that can be planted late in the fall following crop harvest. It produces high amounts of biomass which can result in greater ecosystem benefits (e.g., nutrient uptake) and can be utilized as a high-quality spring forage. Flowering winter cover crops such as winter camelina can provide valuable floral resources for pollinators early in the spring. Planting winter cover crops such as cereal rye and winter camelina can provide multiple management options in the spring, such as utilizing them for stored feed or as a grazed forage or terminating them and allowing them to be incorporated into the soil. However, there can be ecosystem services tradeoffs associated with these approaches. We present a summary of what has been captured in the literature related to the use of cover crops for forage and potential tradeoffs with soil health and other ecological and agronomic benefits. We also present initial findings from an ongoing study that seeks to quantify the benefits and tradeoffs associated with cover crop species composition, i.e., cover crop monocultures versus various mixtures containing winter cereal rye, winter triticale, hairy vetch, and winter camelina, on spring forage production, forage quality, and biological diversity. Data from year one of the study indicates that forage production (dry matter) was not statistically different between winter cereal rye (3524 kg ha-1), winter triticale (3642 kg ha-1), binary mixtures of each of these species with hairy vetch (3271 and 3014 kg ha-1, respectively), or three-way mixtures with the addition of winter camelina (2878 and 2764 kg ha-1, respectively). Pollinator abundance was greatest in mixtures containing winter camelina, which flowers in early spring, but floral resources are short-lived when cover crops are harvested for forage. A summary from the literature will provide further insight into the tradeoffs between utilizing them for spring forage and soil-associated and biodiversity benefits.

Track: 2024 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

Design and assessment of a Sustainable Project Management Framework (SPMF)

Authors: *Rassima Salimbayeva (Narxoz University)**

Currently, much research has been carried out on project management and achieving sustainable development through project implementation. However, the issue of achieving sustainable development is still problematic for project managers and project stakeholders. The authors mainly paid attention to three aspects of sustainable development: ecological, economic and social. In this article, an attempt was made to describe a model of global sustainable project management based on the PESTEL method. Based on this Multiscale Sustainability Project Management Framework, an algorithm for evaluating projects according to sustainability criteria is proposed, which includes the following aspects of sustainable development: political, economic, social, technological, environmental and legislative. Also, an analysis of the literature in the field of project management and sustainable development was carried out. The research's novelty is the Multiscale Sustainability Project Management Framework with more extended sustainability criteria. The main idea of the research is developing Sustainable Project Management Index (SPMI) wich will contribute to the science of project management and project managers of various projects can apply it to evaluate projects according to sustainable development criteria

Track: 2024 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

Pollinator Habitat Establishment on Salt-Influenced Cropland

Authors: *Robert J Glennon (Virginia Tech)**

Rising sea levels have resulted in the loss of productivity in the areas on cropland due to high water tables in the soil and increased soil salinity. These areas are usually abandoned and native plant species volunteer and eventually dominate after decades of competition with non-native species. The Accomac, Virginia field office of the USDA, Natural Resources Conservation Service established a stand of wildflowers on a cooperator's field in the spring of 2019. The seeding was funded by the Conservation Stewardship Program. The species selected had some tolerance to saline soil and were all tolerant of soils with high water tables. They were sown at the rate of 4.5 pure live seeds per square foot, the standard seeding rates for pollinator habitat seedings. The species sown were: swamp rose mallow, common sneezeweed, false aster, yarrow, Saint John's wort, plains coreopsis, bearded beggarticks, Pennsylvania smartweed, and arrowleaf tearthumb. After two years of growth, all of the species were established with varying degrees of success. Swamp rose mallow, yarrow, and common sneezeweed were the most dominant perennial species. Plains coreopsis and bearded beggarticks were the most dominant annual species. A native groundcover, sea purslane, had volunteered and was spreading throughout the stand. Another native wildflower, seaside goldenrod, had volunteered around the edges of the stand. Plugs were planted on the site, and performed well. The goldenrod was not available as seed in 2019, but it is now available as seed and should be included in any future seed mix. The stand will be monitored further to inform future recommendations.

Track: 2024 General Conference Theme

Subject: Adaptive Management of Conservation Efforts

Assessment of Partial Conservation Practice Removal on Water Quality in a CEAP Watershed, Beasley Lake, Mississippi

Authors: *Richard E. Lizotte (USDA)*; LeeVi Haas (USDA-ARS); Martin Locke (USDA-ARS); Matthew Moore (USDA)*

Beasley Lake Watershed is a 6.25 km2 Conservation Effects Assessment Project (CEAP) watershed assessment focusing on the effects of conservation practices (CPs) on water quality. Since the beginning of the project, the watershed established several structural CPs encompassing a total area of 106.6 ha: edge-of-field buffers, Conservation Reserve Program (CRP) set-asides, a constructed wetland, habitat buffers to attract bobwhite quail (Colinus virginianus) (QB), and a sediment retention pond. During June-July 2022, the landowner of a 4.0 ha section of QB along the lake shoreline had approximately 1.6 ha of vegetation completely removed from the buffer coupled with landowner renovation practices (elevated slopes, new

ditches, rerouting storm water, no soil stabilization). The study assessed the effects of partial QB buffer removal on lake surface water quality by comparisons before (2017-2019), during (2022) and after (2023) removal (2020-2021 not included due to pandemic). Lake surface water quality was monitored biweekly and included suspended solids, turbidity, water clarity (Secchi depth), colored dissolved organic matter (carbon CDOM), nitrate, algae (chlorophyll a), and cyanobacteria harmful algal blooms (phycocyanin). Annual median suspended solids and turbidity were significantly lower ($P < 0.001$) after partial CP removal (22 mg/L, 19 NTU) than in 2019 (36 mg/L, 31 NTU) but not different from any other year ($P > 0.05$). Coincidingly, annual median Secchi depth significantly increased ($P < 0.001$) after partial CP removal (40 cm) compared to 2019 (32 cm) but also did not differ from any other year ($P > 0.05$). Annual median carbon CDOM levels after partial CP removal (6 mg C/L) were intermediate relative to 2017-2018 (>6.5 mg C/L) and 2019 (4.9 mg C/L) while annual median nitrate levels after partial CP removal (9 µg/L) were significantly lower ($P < 0.001$) than 2018, 2019, and 2022 (18-32 µg/L). Algal and cyanobacteria levels showed annual median concentrations were significantly lower ($P < 0.001$) after partial CP removal (chlorophyll a, 22 µg/L; phycocyanin, 16 µg/L) than before (chlorophyll a, 30-31 µg/L; phycocyanin, 27-42 µg/L). Broadly, partial CP removal did not significantly impair lake water quality within one year after the change. Lake water quality showed resilience to this small (1.5%) loss of CPs in the watershed.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Assessment of Sugarcane and Flooded Rice Crop Rotation Effects on Soil and Water Quality in the Everglades Agricultural Area, Florida

Authors: *Xue Bai (University of Florida); Donghyeon Kim (University of Florida); Abul Rabbany (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 (American Farmland Trust); Yuncong Li (University of Florida); Donald Meals (Self Employed); Jehangir H Bhadha (University of Florida)**

In the Everglades Agricultural Area (EAA) of South Florida, over 50,000 acres of fallow sugarcane land is available during the summer for rice production with no starter fertilizer (N, P, K) applied. However, the impact of rice cultivation on soil nutrient uptake efficiency and discharge loads haven't been fully discussed. In this study, the effect of sugarcane and flooded rice cultivation on soil and water quality in the EAA was evaluated by conducting experiments on fields with different crop rotation systems, including four-year sugarcane-rice-sugarcane-sugarcane, sugarcane-sugarcane-rice-sugarcane, continuous sugarcane (SSSS) and virgin land. Soil nutrient concentrations such as total phosphorus (TP), Mehlich3 phosphorus (M3P), total Kjeldahl nitrogen (TKN), nitrate (NO3-), and ammonium (NH4+), and water quality concentrations including TP, soluble reactive P, total N (TN), total organic carbon (TOC) and total suspended solids (TSS) are being used as part of the assessment. To assess the effectiveness of the rice-sugarcane crop rotation on soil and water quality, parameters were compared under different cropping systems. Preliminary results showed that NO3- increased at topsoil after the rice cultivation, while there were no significant changes in NH4+, TP, M3P, and TKN. The TSS in the ditch water was higher during rice growing period than in sugarcane. TOC, TN, and NH4+ in the water systems were higher during the rice period than in the sugarcane growing period, especially in groundwater. Conversely, the NO3- in the ground and ditch water were higher during sugarcane planting than in rice. Future study efforts involve calibration of the integrated modeling tool to groundwater level, canal water level, and water quality parameters observed at the study fields, and nutrient loads for system will be evaluated. 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: 2024 General Conference Theme

Subject: CEAP Showcase

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

Authors: *Ronald Bingner (USDA-ARS)*; Robert Wells (USDA); Henrique Momm (MTSU); Eddy J Langendoen (USDA ARS); Dalmo A. N. Vieira (USDA - Agricultural Research Service); Martin Locke (USDA-ARS); Joshua Faulkner (University of Vermont); 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, identifies vulnerable areas within several CEAP 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. Highlighted results for watersheds in Maryland and Vermont will be provided. This work will help identify the appropriate type of conservation practices and target their placement to the erosion source and quantify the amount of soil saved from the entire system. In addition, erosion prediction technologies will be enhanced and applied to evaluate the impact of conservation practices on EGE.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Concentration-Discharge Dynamics Across Temporal Scales in a Drained Agricultural Watershed

Authors: *Mark Williams (USDA ARS)*; Rose Mumbi (Purdue University); Scott McAfee (USDA ARS); Janae Bos (USDA ARS)*

Concentration-discharge (C-Q) relationships reflect watershed processes operating across nested temporal scales and can provide valuable information on the processes driving nutrient sourcing, transformation, and transport. The objective of this study was to examine C-Q relationships at event, seasonal, and annual temporal scales in a drained headwater watershed (20 km2) of the St. Joseph River watershed (Indiana). Daily and high frequency event sampling (2-3 hr) of nitrogen (NH4-N, NO3-N, total N), phosphorus (dissolved reactive P, total P), and hydrologic tracers (electrical conductivity, stable water isotopes) were completed from 2017 through 2020. Meteorological, biogeochemical, and hydrological variables were used to identify and distinguish processes that drive solute export patterns and influence the shape of their respective C-Q relationships. Results from this study will help provide new insights into nutrient behavior and export in drained agricultural watersheds and help identify conservation practices that can be used to mitigate nutrient loss.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Eddy Covariance and Satellite Evapotranspiration Assessment for Irrigated Citrus in the Kaweah Basin, California

Authors: *Ramesh Dhungel (USDA-ARS); Ray G Anderson (USDA-ARS)*; Andrew French (University of Arizona); Todd Skaggs (USDA-ARS); Dong Wang (USDA ARS)*

Kaweah Basin is the most severely water-stressed basin in the San Joaquin Valley of California. Within the basin, citrus production is one of the largest agricultural land user and consumer of surface and ground water resources for meeting crop irrigation needs. Satellite-based evapotranspiration (ET) products such as the OpenET suite of models and other models, including the Backwards--Averaged Iterative Two-Source Surface temperature and energy balance Solution (BAITSSS), have been proposed to assist with large-scale management of water resources. However, the accuracy of these models for both annual total water consumption and short-term crop water management needs to be robustly demonstrated to gain community acceptance. In this study we evaluate OpenET and BAITSSS models against onsite high-frequency eddy covariance measured ET values in two citrus orchards with contrasting cultivars and pruning practices. Preliminary results indicate that most OpenET ensemble models overestimate spring-time ET by 30% or greater with better agreement in late summer. Ongoing work with flux variance partitioning and soil moisture assessment aims to determine if these discrepancies are due to errors in separating ET to evaporation and transpiration and if the accuracy of satellite ET products is correlated with the climatology of the San Joaquin Valley. Improved understanding of crop water use dynamics and ET estimates can assist citrus growers for making more informed decisions on irrigation scheduling and developing conservation practices for the scarce water resources in the Basin.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Evaluating Seasonal R-Factor Values Based on Modern Rainfall Data to Account for Seasonal Land Cover Conditions

Authors: *Allen Thompson (University of Missouri)*; Quang Phung (University of Missouri); Claire Baffaut (USDA–ARS); Ryan McGehee (Iowa State University)*

The Soil Vulnerability Index (SVI) classification has been observed to align with watershed model-based classifications across various watershed conditions when most soil erosion occurs during the growing season. However, when winter and summer precipitation are of similar magnitude and winter land cover is poor, we observed discrepancies between SVI and model-based classifications, with SVI under-estimating vulnerability on flatter slopes and over-estimating on steeper slopes. This suggests that improved SVI classification could be achieved by including some aspects of precipitation characteristics. Results based on a limited number of watershed model simulations found sediment loss to be more consistently related to precipitation than historical RUSLE2 R-values, with the relationship between sediment loss and RUSLE2-R-values varying with seasonal conditions. This presentation investigates the use of modern rainfall data to calculate seasonal R-values and relate them to seasonal sediment loss risk, which may be useful in improving the SVI classification.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Fertilizer Placement Affects Subsurface Phosphorus Loss

Authors: *Kevin King (USDA-ARS)*; Jed Stinner (USDA-ARS); Greg Labarge (Ohio State University); Kathryne R Rumora (USDA-ARS); Mark Williams (USDA ARS); Chad Penn (USDA-ARS)*

Artificial subsurface drainage is a requirement for viable crop production in the poorly drained, cool humid regions of the Midwest United States. However, phosphorus (P) transport through the subsurface drainage system is in part leading to harmful and nuisance algal blooms (HNABs) in Lake Erie, prompting the search and identification for crop production management practices that reduce or minimize these subsurface losses. One such practice that is being explored and promoted through the 4R (Right Source, Right Rate, Right Time, Right Placement) nutrient stewardship and NRCS SMART (Source Method Assessment Rate Timing) program is phosphorus placement, specifically the placement of phosphorus below the soil surface. A replicated plot study was conducted over a five year period in northwest Ohio USA to measure subsurface P losses following broadcast surface application (SB), broadcast surface application followed by a shallow disk incorporation (SB+D), banding with the planter (2x2), and deep placement, 3-5 inches below the row (DP). Subsurface P losses from 2x2 and SB+D treatments were significantly less than losses from the SB and DP treatments. Greater losses from the SB and DP treatments were attributed to connection to preferential flow paths and minimal to no macropore disruption.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

The Upper Washita Basin: Highlights of Recent and Current Activities and Outcomes

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

Research in the Upper Washita Basin CEAP site focuses on the effects of land and conservation management practices on watershed hydrology, soil erosion, nutrient and water budgets. We maintain and expand long-term observational research databases to elucidate water-related processes for agroecosystems within the Southern Plains. Archival and current research is used to improve tools and strategies that integrate soil health and water conservation, including placement of conservation practices for optimal effectiveness in watersheds. We will present the results of projects that include use of the empirical Revised Universal Soil Loss Equation (RUSLE) adapted to a GIS framework to study the spatial variability of soil erosion across landscapes to estimate reservoir sedimentation. The Système-Hydrologique-Européen (MIKE-SHE) model coupled with the sediment transport model is used to compute sediment production at the grid scale. This study is expected to help advance the current estimates of soil erosion by bridging scale differences to capture the large-scale effects of small-scale soil erosion processes. An additional study combined archived soil and water data collected at variable scales within a single watershed to link soil and watershed health. Use of historic soil and water data, and technologies such as remote sensing that provide timely, cost-effective, and accurate measurements of soil and water properties will enable researchers to link long-term measurements with current monitoring efforts. Data collected at this site, and other observational sites will be publicly available and will support a wide range of agroecosystems analysis and modeling research under a wide variety of ARS and other research programs. USDA is an equal opportunity provider and employer.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

How Does Conservation Implementation Affect the Relationship Between Caloric/Protein Production as a Function of Nitrogen and Phosphorus Runoff Losses?

Authors: *Douglas Smith (USDA-ARS)*; Kabindra Adhikari (USDA-ARS)*

Agricultural sustainability must consider more than single measures of outcomes. As an indicator of production and environmental sustainability this presentation will evaluate the relationship between calories or protein production from various agronomic practices compared to N and P runoff losses. This study was performed at the Riesel Watersheds in central Texas. High levels of conservation adoption for grain production resulted -38 to +15% change in caloric yield, whereas caloric yield as a function of nitrogen fertilizer inputs was improved 50 to 200% with greater levels of conservation. Conservation adoption in cattle production resulted in a loss of caloric output (-20 to -53%); however, the caloric output as a function of stocking density was -32 to 28% improved under conservation management. These types of evaluations are needed to ensure environmental outcomes are balanced for overall production.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Incorporating Long-Term Edge-of-Field Monitoring Sites into Colorado's New CEAP Project

Authors: *Erik Wardle (Colorado State University)*; Troy Bauder (Colorado State Univsersity); Peter Kleinman (USDA-ARS); Kyle Mankin (USDA-ARS)*

Colorado has recently been selected as a location for a new CEAP site focusing on the South Platte River basin in the north eastern part of the state. The South Platte River begins high in the Rocky Mountains and supplies significant water for municipal, industrial and agricultural use throughout the basin. The watershed encompasses the full scope of water conservation and quality challenges facing western agriculture. These challenges begin in the forested headwaters of the Rocky Mountains, where annual snowpack, wildfires and other factors can impact hydrology and water quality. Western water management systems include complex distributions of water between agriculture and other end users where management practices and improved decision support systems can play a critical role in agriculture's evolving water future. Agriculture within the watershed includes irrigated, dryland and range production, requiring diverse conservation strategies that, ultimately, must be integrated to ensure systematic approaches to the region's profound water resource issues. Although work under the CEAP program will not begin until 2024, several key projects have been underway in the basin dating as far back as 2010. The CSU Agricultural Water Quality Program (AWQP) conducts edge-of-field (EOF) monitoring to demonstrate and evaluate Best Management Practices impacts on water quality statewide. In this presentation, background information and data will be discussed from ongoing research on this topic. Additionally, concepts on incorporating these site into the Colorado CEAP will be presented. Key practices include vegetative filter strips, conservation tillage and residue management, nutrient management, irrigation water management and conservation cropping systems.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Influence of Agricultural Managed Aquifer Recharge (Ag-MAR) and Organic Amendments on Soil Nitrogen Balance

Authors: *Helen Dahlke (University of California, Davis)*; Wenyi Cui (University of California, Davis); Tiantian Zhou (University of California, Davis); Elad Levintal (Ben Gurion University of the Negev); Cristina Prieto Garcia (University of California, Davis)*

Agricultural managed aquifer recharge (Ag-MAR) is a practice to sustain groundwater reserves by recharging excess surface water such as flood flows into aquifers when available. Using agricultural lands as spreading grounds for intentional groundwater recharge, however, raises concerns about leaching of legacy nitrogen to groundwater. Previous studies on nitrate losses and N cycling during and after Ag-MAR have found when flooding for Ag-MAR ended and soils drained, the re-entry of oxygen into the soil stimulates mineralization of organic-N thereby increasing soil nitrate, which could be a valuable nutrient source to crops in the following growing season, possibly reducing fertilizer inputs. In this research we model the influence of organic amendments (e.g. crop residue) and different Ag-MAR timings (e.g. Jan/Feb/March) and Ag-MAR durations on carbon and organic N pools, denitrification during recharge, and the mineralization after recharge. The study uses data from a farm field located in the Central Valley, California, which was continuously flooded in February of 2021 for 8 days for groundwater recharge. The field was then planted with processing tomato for the following growing season. DSSAT, the Decision Support System for Agrotechnology Transfer tool, a suite of integrated, process-based models that simulate crop growth and development was used to simulate soil organic matter, soil nitrogen, and crop response under different Ag-MAR and soil management scenarios. Initial findings indicate that organic amendments from the last growing season can promote denitrification during the Ag-MAR flooding period and mineralization after recharge events. Moreover, simulations suggest that the timing and duration of Ag-MAR affects the amount of nitrate leached and nitrate stored in the root zone.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Integrated Hydrologic Model Calibration with Groundwater Age Tracer Data

Authors: *Zhendan Cao (University of California Davis); Giorgos Kourakos (University of California Davis); Thomas Harter (Univ California Davis)**

Age tracers such as tritium, CFCs, and C-14 are effectively nonpoint source (diffuse source) "pollutants" in a regional groundwater basin. In groundwater flow and transport modeling, the travel time of age tracers in the groundwater system provides a unique tool to validate the accuracy of aquifer parameters such as aquifer porosity, recharge rate, and unsaturated zone properties. We apply known age tracer source data to the Non-point Source Assessment Tool (NPSAT), a flow and transport model. Our study area is the 20,000 sq.mile Central Valley (CV) aquifer system, California. CV-NPSAT is a stochastic flow- and transport modeling framework based on two regional hydrogeological models (i.e., C2VSim and CVHM) to simulate, among others, age tracer distribution in the CV groundwater system. Though underlying regional hydrogeologic models were calibrated based on historic head and flow data, CV-NPSAT further allows for evaluation against measured groundwater age tracer data. We calibrate CV-NPSAT (CVHM2-NPSAT and C2CVSIM-NPSAT) using measured age tracer concentration as calibration targets and aquifer porosity, recharge rate, and unsaturated zone porosity as primary and secondary calibration variables, respectively. For cross-validation, we compare groundwater ages obtained from the calibrated age tracer model with the ages obtained from the conceptually simpler Lumped Parameter Models (LPMs). Results indicate that effective porosities in the aquifer are relatively high (near 40%) suggesting that vertical transport across fine-textured, interbedded aquitard layers play a significant role in aquifer transport to irrigation and public supply wells, despite extensive lateral coarse-textured sand-beds.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Poster Number 16

Irrigation Pond Water Storage and Nutrient Variability Using Field and Remotely Sensed Data

Authors: *Alisa W. Coffin (USDA-ARS)*; Andrea Albright (USDA-ARS); Oliva Pisani (USDA-ARS); David D Bosch (USDA); Tim Strickland (USDA-ARS)*

Farm ponds are an ubiquitous feature of many agricultural landscapes due to their use for crop irrigation. And at the same time, most small water bodies have been ignored as reservoirs of water storage, carbon sources and sinks, despite their large number in the global landscape. Ponds at first glance are assumed to contain surface water from precipitation and surface runoff, but in this study deep groundwater is being pumped into the pond to maintain a supply of water for irrigation. Dissolved organic carbon (DOC) fluctuations in such ponds are currently poorly understood, and water quality measurements were taken throughout 2022 to quantify and characterize DOC. Additionally, ponds can be difficult to study using satellite remote sensing due to their small size relative to image resolution, and in this case, Unmanned Aircraft Systems (UAS)-mounted optical imagery and photogrammetrically derived products were used to assist in characterizing a farm pond. Together this study presents an integrated analysis of a typical irrigation pond in South Georgia that synthesizes water inputs and withdrawals, a fused topobathy surface to water volume model, and quantifies and characterizes DOC over a typical crop year.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Modeling Nitrate Removal from Subsurface Drainage by Saturated Buffers

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

A saturated buffer (SB) is an edge-of-field practice which removes nitrate-nitrogen (NO3-N) from subsurface drainage by diverting it to a vegetated buffer as shallow groundwater flow where NO3-N is removed by denitrification and plant uptake. Here, we model discharge and NO3-N load exiting field drain, flow diverted to SB, and SB's NO3-N removal efficiency. Modeling includes a 3-step approach: 1) estimating field drainage discharge and NO3-N load using DRAINMOD, 2) performing mass balance of water and NO3-N at the flow structure based on DRAINMOD computed field drainage discharge and conductivity of the buffer, and 3) estimating NO3-N removal from the discharge diverted to buffer using a first-order reaction equation and buffer soil properties.

Modeling of NO3-N removal was performed for a site in Central Iowa (BC-1) monitored for drainage discharge and NO3 from field and discharge diverted to a SB. Monthly field and diverted discharge to the SB were modeled for 4 years (2014-2017) with RMSE of 1.84 cm and 0.70 cm, respectively. Finally, monthly NO3-N removed by the SB was estimated with RMSE of 2.33 kg using a removal coefficient of 0.275 d-1, measured soil temperature, and soil hydraulic properties. Modeling results will be verified for years 2018-2022.

The calibration results indicate that a simple modeling framework utilizing stepwise estimation procedures at different components of a SB based on soil, drainage, and climate information can estimate its NO3-N removal efficiency with high accuracy. This modeling approach can aid in decision support for reducing nutrient losses from agricultural lands.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Nutrient, Instream Habitat, and Fish Responses to Planting Grass Filter Strips Adjacent to Agricultural Headwater Streams

Authors: *Peter Smiley (USDA Agricultural Research Service)*; Ashlee Balcerzak (Civil and Environmental Consultants); Margaret M Kalcic (University of Wisconsin-Madison)*

Grass filter strips (CP21) are a widely used conservation practice in the United States to mitigate agricultural impacts on streams and rivers. Yet, only a limited amount of information is available on the long-term effects of grass filter strips on nutrients, instream habitat conditions, and stream fishes at the watershed scale. Our objective was to document the long-term effects of planting grass filter strips adjacent to channelized agricultural headwater streams on nutrients, instream habitat, and fish community structure. Riparian habitat, nutrients, instream habitat, and fishes were sampled for 10 years from three channelized headwater streams without grass filter strips, three channelized headwater streams with grass filter strips, and two unchannelized streams having forested riparian habitats in central Ohio. Linear mixed effects model analysis was used to quantify the effects of riparian habitat type and time on the response variables. Mean riparian width, woody vegetation density, and percent canopy cover was greater ($P < 0.05$) in forested streams than unplanted and grass filter strip streams. Mean nitrogen and phosphorus concentrations did not differ among riparian habitat types. Annual and seasonal dissolved organic carbon concentration trends differed ($P < 0.05$) among riparian habitat types. Mean wetted width, mean dominant grain size, and percent instream wood did not differ among riparian habitat types. Annual trends in water depth, water velocity, and instream habitat diversity differed among riparian habitat types ($P < 0.05$). Fish species richness, abundance, percent darters, sunfish species richness, minnow species richness, and percent headwater fishes did not differ among riparian habitat types. Annual trends in darter species richness differed ($P < 0.05$) among riparian habitat types. Our results suggest grass filter strips should not be implemented alone, but in conjunction with conservation practices that will improve water quality and physical habitat quality, and subsequently benefit the fish communities.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Scaling-Up: Does the Overapplication of Fertilizer to a Single Field Affect Watershed Water Quality?

Authors: *Rose Mumbi (Purdue University)**

Nutrient loss from agricultural fields and watersheds continues to be an important water quality issue because of the critical role nutrients play in surface water eutrophication. Excessive application of fertilizers to agricultural fields can result in increased nitrogen (N) and phosphorus (P) loss in both surface runoff and subsurface tile drainage; however, it is not well known how management practices on a single field affect watershed scale water quality. The objective of this study was to evaluate the trends in watershed water quality before and after overapplication of fertilizer to a single field (6 ha of 80 ha; ~8% of the total watershed area). Discharge and water quality were monitored in a tile-drained headwater watershed in northeastern Indiana for a period of 11 years, with 7 years of business-as-usual management, 3 years of overapplication of fertilizer to the single field, and 1 year returning to business-as-usual. Soil samples were also collected throughout the watershed (n=11 locations) annually (2020-2022 during the overapplication period) to assess soil nutrient status with the change in nutrient management. Preliminary results suggest that both watershed NO3-N and dissolved reactive P concentration increased following elevated fertilizer application rates to the single field. Nutrient concentrations remained elevated compared to baseline levels even after the return to business-as-usual management indicating potential lag times and nutrient legacies. Quantifying the impacts of field-scale nutrient management on watershed nutrient losses is critical for meeting nutrient reduction goals in freshwater systems and implementing nutrient management practices to decrease nutrient delivery in tile-drained landscapes. Study results will help create a better understanding of the spatial and temporal aspects of watershed response to nutrient management changes which can help improve conservation practices.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Soil Health Responses to Cropland Management

Authors: *William Osterholz (USDA ARS)**

Generating healthy soil is one goal of several cropland management practices, such as reduced tillage, manure application, diverse crop rotation, and cover crops. However, the effectiveness of these practices for enhancing soil health indicators beyond plot-scale research remains uncertain. This research assessed how 5 years of management practices influenced soil health indicators across 40+ commercial crop (primarily corn and soybean) fields in Ohio. Indicators of soil health included soil organic carbon, soil respiration, aggregate stability, bulk density, active C, and soil protein. Results will reveal the specific effects of management practices on the soil health indicators. Insights from this work will include estimating the relative effectiveness of management practices for improving soil health in Ohio, in turn helping farmers prioritize management practices that are most likely to improve soil health.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

STEWARDS: Watershed Data System History and Future

Authors: *Kevin J Cole (USDA ARS NLAE)*; Michelle Cryder (USDA ARS NLAE)*

The Sustaining the Earth's Watersheds-Agricultural Research Data System (STEWARDS) online data system was developed for the Conservation Effects Assessment Project (CEAP) by a team from several USDA Agricultural Research Service (ARS) locations. The goal was to share ARS watershed assessment data with the scientific community and the public to advance conservation science. The system went live in 2007 and continues today. Data is continually added with 19 benchmark watersheds in the system. The system contains over 25 million records and over 53 million data records have been downloaded. The rate of downloads has ranged from 500,000 to over 12,000,000 per year. Greater data exposure had occurred when the STEWARDS data was linked to the USGS Water Quality Portal and was available through their website and application programming interface (API). New data discovery and exploration tools were recently developed to make data access easier. The STEWARDS team is working with the Natural Resources Conservation Service to meet future needs.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

The Many Benefits of Buffers on Cropland Soils with High Runoff Potential

Authors: *Claire Baffaut (USDA–ARS)*; Kristen Veum (USDA-ARS)*

Buffers are well known for trapping sediment and associated nutrients from crop or pasture land. However, they have other benefits such as herbicide degradation and soil restoration. This presentation will summarize the soil health and water quantity and quality results from two experiments in the Goodwater Creek Experimental Watershed in Missouri on high-clay soils with a restrictive layer close to the surface. The first experiment investigated the fate of sediment, nutrients, pesticides, and veterinary antibiotics from a fallow source area in buffers planted with tall fescue and different warm season grasses. Warm season grasses were effective at reducing sediment, nutrients, and pesticides in runoff. In contrast, only tall fescue was effective at reducing veterinary antibiotics but required a large source to buffer area ratio to achieve meaningful reduction. The second experiment investigated the water quantity, water quality, and soil health effects of a 50-m wide switchgrass buffer established at the steepest part of 200 m long grain crop plots under two tillage systems. These buffers did not affect the runoff amount at the bottom of the plots. We will present the effects of these buffers on sediment, nutrient, and pesticide concentrations. Further, the soil health status was compared across varying production systems, illustrating the biological and physical soil health benefits of conservation practices such as perennialization, enhanced crop rotations, cover crops, and reduced tillage.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Two-Stage Ditch Nitrogen (N) and Phosphorus (P) Retention During Five Flow Regimes

Authors: *Kathryne R Rumora (USDA-ARS)*; Brittany Hanrahan (USGS); Kevin King (USDA-ARS); Jed Stinner (USDA-ARS); Gregory LaBarge (OSU)*

Channelized (i.e., trapezoidal) agricultural ditches are designed to quickly move water away from fields, which exacerbates nutrient and sediment loss from agricultural watersheds, particularly during times of high flow. The two-stage ditch design is an in-stream conservation practice that constructs in-set floodplains, allowing water to spread out and slow down during periods of high flow and critical nutrient transport. The objective of this research was to examine the influence of a two-stage ditch on patterns of nitrogen (N) and phosphorus (P) export across seasons and hydrologic-flow regimes from an agricultural watershed in northwest Ohio. To that end, we employed a mass balance approach where the sums of daily nutrient inputs to the two-stage ditch were subtracted from daily nutrient output to assess the hypotheses that the two-stage ditch would most effectively retain N and P during the wettest seasons (winter and spring) and during the highest flows. The mass balance approach estimated a change (Δ) in daily nitrate (NO3--N), total N (TN), dissolved reactive P (DRP), and total P (TP) loads, which we referred to as the two-stage effect (Δ2stage); negative values (i.e., inputs > outputs) indicated that the two-stage ditch reduced nutrient export. Preliminary results indicate that NO3--N, TN, DRP, and TP outputs from the two-stage ditch were lower than inputs on 77%, 79%, 75%, and 78% of days, respectively, indicating that the two-stage generally decreased nutrient export from the watershed during the study period. We compared Δ2stage among flow regimes and found that Δ2stage was most negative during high flows for NO3--N, TN, DRP, and TP; however, seasonal patterns of Δ2stage varied between N and P such that Δ2stage was most negative during the fall for NO3--N and TN and during the winter for DRP and TP. These preliminary results indicate that the two-stage ditch most significantly decreased N and P export from an agricultural watershed during high flows and non-growing seasons when fields are at greater risk for increased nutrient leaching. This study expands understanding of the two-stage ditch as a conservation tool for managing nutrient losses at the watershed-scale.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

What Does Microbial Enzymatic Activity Tell Us About Organic Soil Conservation Associated with Cover Cropping within the Everglades Agricultural Area of South Florida?

Authors: *Noel Manirakiza (University of Florida); Yang Lin (University of Florida); Abul Rabbany (University of Florida); Allan R. Bacon (University of Florida, Soil and Water Sciences Department); Michael Andreu (University of Florida); Jehangir H Bhadha (University of Florida)**

Conservation and protection of soil resources are globally recognized goals for the pursuit of sustainable agriculture. Cover crops can aid achieve these goals as it is an accessible and adaptable soil conservation practice that can be incorporated into agriculture production systems. This study evaluated the potential use of cover crops for soil conservation within the Everglades Agricultural Area (EAA), which is a drained wetland that has exposed over 500,000 acres of organic soils (Histosols) for agricultural purposes, leading to accelerated soil loss via microbially-mediated organic matter (OM) oxidation, locally referred to as "soil subsidence". Information regarding cover crops in conserving soil loss in the region is limited. This study compared the effects of cover crops and other farming practices on microbial enzymatic activities associated with OM and nutrient mineralization. A field study composed of the following treatments was conducted: Cover crops including (i) Flooded rice (Oryza sativa) [FR], (ii) Sorghum Sudangrass (Sorghum bicolor) [SS], and (iii) Sunn hemp (Crotalaria juncea) [SH]; in addition, (iv) Sugarcane (Saccharum officinarum) [S]; (v) Flooded fallow [FF]; and (vi) Fallow [F] treatments were also evaluated. Pre- and post-soil samples were collected at 0-15 cm depth for analyzing four microbial activities associated with OM oxidation and nutrient mineralization including, β-1,4-Glucosidase (β), β-N-acetylglucosaminidase (NAG), Alkaline phosphatases (AP), and Aryl sulfatase (AS). Results revealed that β, NAG, and AP activities significantly ($P < 0.05$) decreased under FR. NAG, AP, and AS activities significantly ($P < 0.05$) increased under S, indicating the potential of nutrient mineralization under sugarcane farming practice. Traditional cover crops like SH and SS showed no significant changes in soil microbial enzymatic activity. To conclude, results of microbial activities show that cultivating flooded rice can potentially conserve soil loss by minimizing microbial enzymatic activity in Histosols within the region.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Land Use Specific Tracer Illuminates Agricultural Nitrate-N Fate in the CEAP Choptank River Watershed

Authors: *Dylan Owen (USDA ARS); Greg W McCarty (USDA ARS)*; Cathleen J Hapeman (USDA-ARS); W. Dean Hively (USGS); Clifford P. Rice (USDA-ARS, Beltsville, Systainable Agricultural Systems Lab)*

Despite a plethora of research efforts and nutrient management strategies applied to the Chesapeake Bay watershed for nearly a century, water impairment continues to be an issue. A major concern is non-point source pollution from agricultural nitrate. However, a barrier to understanding the relationship between land management and water quality improvement is lag time in watershed response, groundwater transport dynamics and variability, and uncertainty in management practice effectiveness. While previous research has independently either analyzed nutrient trends to determine effectiveness of nutrient management or characterized watershed lag time it has not considered these two topics in unison or focused them on agriculture. Additionally, when watershed lag time is discussed, it does not take into account the unique hydrology of croplands. From 2007 – 2019 water samples were measured for both nitrate and MESA (a metabolite of the commonly used cropland herbicide, Metolachlor) from 18 subwatersheds of the Choptank basin. By utilizing the uniqueness of MESA as a land use specific conserved transport analogue of agricultural nitrate, this research illuminates nitrate dynamics and watershed variability. In addition, the long-term monitoring of these sites will assist in characterizing the groundwater mixing rate and the replacement rate of older water within the system. The improved understanding of nitrate fate in complex agricultural watersheds will be utilized in SWAT+ modifications and will lead to improved management strategies for reduction of agricultural nitrate export to sensitive aquatic ecosystems.

Track: 2024 General Conference Theme

Subject: CEAP Showcase

Agricultural Informatics for Sustainable Soil, Crop and Landscape Management

Authors: *Maruthi Sridhar Balaji Bhaskar (FIU)**

The adoption of conservation agriculture practices among the small-scale urban organic farmers in South Florida and elsewhere has been growing in recent years. Precision conservation agriculture includes timely collection of geospatial information regarding soil, plant properties and conservation practices, and later applying site-specific management practices to optimize production while protecting the environment. The two farms involved in the study are Possum trot farm and Lions farm located in Redland farming region of Homestead, Florida. The regions subtropical weather and calcareous soils are suitable to grow variety of tropical fruits, palm trees, vegetables, and specialty crops. The objectives of the study are 1) To collect and analyze the physical and chemical characteristics of the soil and plant samples from two selected organic agricultural farms located in Redland region of South Florida, 2) To process and map the crop sensor, GPS, drone and satellite data obtained from these agricultural farms, and 3) Analyze the geospatial data to map the nature and pattern of the soil nutrient availability and plant productivity. Soil and plant samples were collected from Possum trot farm and Lions farm during summer. Samples were analyzed for nutrient and metal concentrations. The Soil C and N concentrations were higher to the northern and eastern borders of the field indicating edge effects. The spatial variability of the plant and soil physical and chemical characteristics indicate that the LAI, RWC and Chlorophyll content remain varied and is dependent on the plant species, canopy and composition. The C:N ratio of the soils remains above 24:1 for most of the study region. Our research findings will help organic farmers to experiment and improve farm management decisions to allocate resources and increase efficiency while improving their farms and environment.

Track: 2024 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); Jeff Brady (Texas A&M AgriLife Research Center); Paul DeLaune (Texas A&M AgriLife Research); Edward Osei (Tarleton State University); Kartik Venkataraman (Tarleton State University); Caitlyn Cooper (Texas Tech); Jennifer Spencer (Texas A&M Extension)*

Our project is developing a biochar-assisted phytoremediation systems for enhancing water quality following nutrient contamination during dairy manure application. In this project, the calcium-functionalized biochar (Ca-BC) was prepared, and applied to the fields with different soils, plants, manure application, and tillage/no-tillage. From our lab analysis, Ca-BC possessed high capacities for removal of reactive P, antibiotics, and E. coli pathogens. The capacities of Ca-BC were higher than the pristine BC and commercial activated carbon. The field experiments (microplots) were conducted under various biochar types (pristine BC, Ca-BC), soils (sandy, sandy loam), crops (forage, grain, and energy crops), manure application, and tillage/no-tillage. From the field demonstration, several results were found: (1) The BC application had little effects on forage yields and nutrient values, with some decrease of micronutrients due to the adsorptive removal of micronutrients by the BC, (2) The BC application decreased the phosphorus, antibiotics, and microbes (coliform bacteria), and (3) The BC application led to more diverse microbial communities, particularly related to C and N cycles. In addition to the microplot field experiments, the infiltrate water samples were analyzed, and the results showed lower organic carbon, P, and antibiotics with the Ca-BC amended plots. We will continue to conduct the microplot and water quality experiments to see the detailed effects of BC and Ca-BC on soil and water quality, and crop productivity. Lastly, this project supported potential applications of calcium-functionalized biochar to the manure-applied fields for significant reduction of nutrients and environmental contaminants in soil and water under the appropriate conditions (e.g., 5-10 tons of BC/ha, 5% manure application). This outcome can be immediately applicable to the manure-applied fields with similar weather, soil, and plant types (e.g., semi-arid, sandy loam/clay soils, forage-grain-energy crops). With additional investigation, the same outcomes would be further applicable to the manure-applied fields with other field conditions.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Climate-Smart Productive Alley Cropping System (PACS) for Income Diversification and Farm Resiliency

Authors: *Sougata Bardhan (Lincoln University)*; Raelin Kronenberg (Lincoln University)*

Changing climate poses new and expanding challenges to meeting the food and fiber requirements for a growing human population. Shifts in temperature, precipitation, and wind patterns dramatically alter important ecosystem services and functions. A well-designed alley cropping system offers an alternative to conventional agricultural practices that provide many benefits beyond carbon sequestration. There are direct positive impacts on human health and well-being, including the provision of food and fiber, the creation of additional recreational opportunities such as photography, support for mental/emotional wellbeing through improved aesthetics and connection to nature, as well as access to highly nutritious food crops including maple syrup, honey, berries, and nuts.

Alley cropping can produce diverse products, leading to the system's greater ecological and financial resilience. The marketing of climate-smart produce can help producers access a niche market of consumers concerned with climate change and eating local foods. The alley cropping system generally produces an abundance through the careful management of multiple species (for example, stacking production of berries, specialty crops, maple syrup, and honey), known as the concept of over-yielding.

This project will develop climate-smart production opportunities for historically underserved, small, and resource-limited farmers. A well-designed alley cropping system can provide high-value yields of specialty crops compared to their land footprint. Alley cropping can provide small farmers with a diverse, economically viable production alternative that also provides crucial ecosystem services for their farm and community.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Colorado Soil Health Program: Supporting Producers Improve Soil Health

Authors: *Kristen Boysen (CO Dept of Agriculture)*; John Miller (CO Dept of Agriculture); Liza Nguyen (CO Dept of Ag); John Rizza (CO Dept of Agriculture)*

By leveraging our Conservation Innovation Grant and additional state, federal, and private funding, Colorado's Soil Health Program has expanded from our initial 100 producers to more than 400 across 11 different crop types. The practice-based Soil Health Program supports producers by 1) Providing technical support through state and Colorado State University Extension staff, 2) Matching practice implementation costs, up to $75/acre, 3) Outlining a clear path to improvement, using the 5-star Colorado STAR Field Evaluation Form, and 4) encouraging branding and market premium opportunities with the STAR logo as well as marketing support from CDA.

The Colorado Soil Health program empowers local implementing partners- conservation districts, commodity groups, urban agricultural promoters, and tribes and acequia associations – to support producers who would not otherwise participate in a state program. These local experts provide on-the-ground support to producers, and develop community networks of soil health experts.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Covering Ground: Investigation of Cover Crops for Soil Health in the Great Lakes Region

Authors: *Dennis Busch (Water Resources Monitoring Group LLC)*; Andrew Cartmill (Water Resources Monitoring Group LLC); Anthony Busch (Water Resources Monitoring Group LLC); Will Keast (Water Resources Monitoring Group LLC)*

Our On-Farm Conservation Innovation Grant project focuses on the investigation of a variety of innovative conservation approaches directly related to soil health and the use of cover crops, through robust on-farm demonstrations and research at the plot, replicated strip, field, and paired-basin scale. The conservation approaches have been designed through iterative discussion with farmer-led watershed groups to match issues and challenges particular to their geographic region and production systems.

Data presented will focus on results of edge-of-field runoff monitoring, rainfall simulations, and soil health data collections across multiple farms participating in the On-Farm Trails program. Specific practices evaluated include strip-till, no-till, cover crops, interseeded cover crops, and livestock grazing practices.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Exploring Relay Intercropping in Iowa: Early Findings from Farmer Engagement

Authors: *Jacqueline Comito (Iowa State University)*; Jon Dahlem (Iowa State University); Matthew Helmers (Iowa State University); Mark Licht (Iowa State University); Mitch Harting (Iowa State University); Alena Whitaker (Iowa State University)*

The main objective of this CIG funded project is to demonstrate the advantages of a relay intercropping system in Iowa to maintain or enhance productivity and profitability while improving soil health and nutrient reductions in comparison to small grain cover crops grown in the off-season between corn and soybean crops. One of the goals of this project is to identify the social factors influencing relay intercropping adoption at an early stage in the statewide introduction of this innovative practice. The Iowa Learning Farms project team worked with Iowa State University Extension and Outreach, Iowa Soybean Association, and Northeast Iowa RC&D and recruited local farmers and stakeholders from the six demonstration areas to participate in a Rapid Needs Assessment and Response (RNR) workshops in each area. This poster presents the findings of those RNR workshops conducted during February and March of 2024. RNR workshops achieve two goals: 1) It is a structured networking event that allows participants to focus on the topic and also learn about the topic through peer discussions; and 2) Helps facilitators to identify participants' existing knowledge on the topic so that they can tailor workshop information to participant needs and questions. The use of the RNR workshop format in this project allowed the social scientists to create a baseline of relay intercropping knowledge at the beginning of the project, in addition to observing peer interactions and understanding local social dynamics.

Track: 2024 General Conference Theme

Subject: CIG Showcase

High Clearance Robotic Irrigation for In-Season Nutrient Management

Authors: *Kapil Arora (Iowa State University)*; Jake Willsea (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.

First year replicated strip trials with three treatments of Fall, Spring, and In-season application have occurred with robotic irrigation using 360 RAIN Robotic Irrigator. In-season application consisted of traditional N and P application rates as well as reduced rates to take advantage of better matching nutrient availability to corn needs. Measurements were made for dissolved reactive phosphorus losses with both runoff and leaching using commercially available nutrients.

Secondly, as climate shifts result in water scarcity during critical stages of crop growth, robotic irrigation water applications were used to meet the crop needs. Corn yields were measured to evaluate the impact of this proposed strategy.

First year field data for both Ohio and Iowa is currently being analyzed and will be presented in the poster. Results will demonstrate that high-clearance robotic irrigation, a climate-smart technology, improves profitability while reducing negative environmental impacts.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Innovative Technologies to Reduce Beef Industry GHG Emissions

Authors: *Nathan D DeLay (Colorado State University)*; Kim Stackhouse-Lawson (Colorado State University); Sara Place (Colorado State University); John Ritten (Colorado State University); Mark Enns (Colorado State University); Justin Derner (USDA ARS); Larry Kuehn (USDA ARS); EJ Raynor (Colorado State University); Anna Shadbolt (Colorado State University)*

This poster presentation will disseminate initial results from the NRCS Conservation Innovation Grant (CIG) award "Innovative Technologies to Reduce Beef Industry GHG Emissions." Initial results will focus on Objectives 1 and 2 below, including the multi-site and communal grazing, and cattle finishing portions of the project. Specifically, we will report baseline GHG emissions measures from the GreenFeed enteric methane system (C-Lock Inc., Rapid City, SD) from cattle of different origin and production systems.

The beef cattle industry is vitally important to U.S. agriculture, making up 17% of all agricultural commodity sales nationwide in 2021. The livestock industry has come under pressure to address climate change due to its contribution to atmospheric methane (CH4), a powerful greenhouse gas (GHG). To generate scalable GHG-mitigating solutions, the impacts of potential interventions must be understood, with careful attention to the economic tradeoffs faced by decision makers.

The goal of this project is to reduce GHG emissions through climate-smart and regenerative practices, demonstrate the use of innovative and existing technologies for GHG reductions, and develop and test a pilot market-based program that benefits underserved producers. This proposal serves the dual interests of mitigating the livestock industry's impact on climate change while providing a market incentive for emission reductions that can diversify producers' income. The geographic scope for this project spans the Western Plains region, a vital region for the U.S. beef production.

To reach this goal, the project will pursue the following objectives in order of execution:

Objective 1: Evaluate enteric CH4 emissions from cattle in multi-site experimental backgrounding systems. We will first establish GHG emissions under typical business-as-usual production systems at three different locations.

Objective 2: Measure changes in GHG emissions and production outcomes resulting from the implementation of conservation management practices in grazing and feedlot systems.

Objective 3: Design a pilot market-based inset program based on demonstrated GHG reductions.

Objective 4: Analyze the GHG reduction market to inform policymaking at scale.

This project will result in a pilot inset market for CO2e reduction for two key segments of the beef value chain: stockers and cattle feeding operations. Emissions-reductions will be evaluated holistically to understand the production costs, benefits, and tradeoffs associated with achieving

them. To accomplish these goals, this project involves strategic partnerships with industry stakeholders across the beef supply chain.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Leveraging Soil Health Data for Improved Cotton Yield Prediction to Nitrogen Fertilization

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

Achieving sustainable agriculture requires the adoption of conservation management to improve soil health and modifying fertilizer recommendations based on changes in soil health conditions. While there is a growing interest among producers in implementing conservation practices such as cover crops and reduced tillage, existing nitrogen (N) fertilizer recommendations are based on target lint yield goals and often do not account for crucial soil biochemical and environmental factors. On-farm trials were conducted across a diversity of sites in South Carolina, focusing on the use of winter cover crops and conservation tillage in cotton-based cropping systems. The impacts of these conservation practices on soil health and farm profits were evaluated. Baseline soil samples were collected from 0-10 cm, 10-30 cm, and 30-60 cm depths to characterize soil biochemical, chemical, and physical conditions. In each trial, four N rates were applied once cotton emerged to assess cotton lint yield response to N availability. Approximately 50% of the trials exhibited a significant lint yield response to N fertilization. We will present conceptual relationships between lint yield and soil biochemical properties—such as baseline inorganic N and soil-test biological activity, shedding light on the factors contributing to non-responsiveness to N fertilization at certain sites. The findings from this study will help us improve cotton N fertilizer recommendations, ultimately enhancing farm profitability and promoting the environmental sustainability of cotton production.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Mitigating Enteric Methane Emissions in Dairy Cows via Feed Management Practices: Dairy Farm Advisors' Perspective

Authors: *Juan Tricarico (Dairy Management Inc.)*; Partha Ray (The Nature Conservancy); Alisha Staggs (The Nature Conservancy); Ricardo Costa (The Nature Conservancy); Joel Leland (The Nature Conservancy); Lara Moody (Institute for Feed Education and Research)*

This project aims to achieve the overall goal of scaling adoption of feed management strategies to reduce enteric methane emissions through increased use of NRCS feed management standards and cost-share programs by integrating social (e.g., surveys) and natural science (e.g., on-farm trials). Feed management strategies are not widely used currently by the NRCS Environmental Quality Incentive Program (EQIP) or the NRCS Conservation Stewardship Program (CSP), and carbon markets do not reward them. The project has four objectives: (1) test feed additives that can lower methane emissions in MI and WI dairy farms; (2) get feedback and guidance from an expert panel of industry, academic, and public-sector experts on the feed strategies; (3) survey and interview key stakeholders, such as dairy producers, feed suppliers, nutritionists, veterinarians, extension agents, and policy makers, on their views and needs about feed management and methane mitigation; and (4) share results from trials and stakeholder engagement to develop recommendations and best practices for mitigation through feed management. While on-farm trials are ongoing, and we expect results to be available in 2024 and 2025, we present here the results of a survey conducted to understand the attitudes of dairy farm advisors toward feed management strategies that can lower methane emissions from dairy cows and challenges associated with their adoption. The respondents were dairy consultants, educators, nutritionists, veterinarians, feed mill, dairy cooperatives, and NRCS staff. There were 42 respondents from various regions and states in the U.S. Most respondents (69%) did not know the NRCS conservation practice standard 592, and only 29% of those who knew it had suggested it to dairy producers. The most well-known feed additives to reduce methane emissions were ionophores (e.g., Rumensin) and essential oils (e.g., Agolin), with 86 and 88% of respondents aware of them, respectively. More than two-thirds of respondents (67%) had advised their clients to use feed additives to lower enteric methane emissions, and the main factors they considered when selecting a feed additive were the cost, performance, and function of the additives. The main concerns and challenges for advising feed additives to reduce enteric methane emissions were the cost-benefit ratio, the quality and effectiveness of the additives, and the negative reactions or attitudes of clients. The respondents agreed that consumers should pay the most for using feed additives, followed by brand marketers and dairy cooperatives, while farmers and USDA/NRCS should pay the least. The respondents wanted more research and education on unbiased (36%) and scientifically proven (29%) information on the economic and environmental benefits of feed additives to lower enteric methane emissions in dairy cows.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Modernizing Fertilizer Recommendations: The Fertilizer Recommendation Support Tool (FRST) Project

Authors: *Nathan Slaton (University of Arkansas)*; Deanna Osmond (North Carolina State University); John Spargo (Penn State University); Matt Yost (Utah State University); Daniel Kaiser (University of Minnesota); Luke Gatiboni (North Carolina State University); Greg Buol (North Carolina State University); Qudus Uthman (University of Arkansas `); Uzair Ahmad (University of Arksansas)*

Soil testing is the first step in sustainable phosphorus (P) and potassium (K) nutrient management and provides the backbone for nutrient management in modern agricultural systems. Most soil test recommendation systems are derived from poorly documented, decades-old research conducted under historic climate conditions and production practices. The Fertilizer Recommendation Support Tool (FRST) Project has the goal of assimilating soil test correlation and calibration data into an accessible database that can be used to develop and model scientifically defensible, transparent, soil-test-based fertilizer-P and K management recommendations. Modern, science-based recommendations are fundamental to profitable and sustainable production, soil health, and environmental protection. The national database contains trial mean or replicate data from more than 1200 P and 1000 K fertilization trials. Additional legacy and new data are being added. The initial version of the FRST identifies the critical soil test value for soil test P and K methods with a critical volume of data in the national database. The application has features that allow the selection of individual or multiple states or for the user to identify an area with their own geographic boundary. Additional filters allow the user to identify and select specific soil series and sample depths. The FRST Project is multidimensional and has activities examining lime recommendations, modeling fertilizer-P and -K rate calibration, reviewing differences in land grant institution recommendations, mentoring young professionals, and educating stakeholders in soil testing and fertility management. Input from the agricultural industry is being sought via a national survey and engaging industry groups, farmers, and consultants. This poster will provide a first look at the decision support application and review FRST activities that seek to harmonize and provide clarity to soil-test-based fertilizer-P and -K recommendations in the US.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Perceptions of Adoption and Environmental Benefits of Silvopasture Systems by Forage-Livestock Producers in the Southeastern United States

Authors: *Lydia O'Halloran (Clemson University)*; Liliane Silva (Clemson University); Debabrata Sahoo (Clemson University); Gafar Agunbiade (Clemson University)*

Under proper management, silvopasture systems support the delivery of ecosystem services (e.g., habitat provisioning, carbon sequestration, water filtration) while enhancing forage and livestock production and diversifying producer revenue sources. Native warm-season grasses are a viable option for use in South Carolina silvopasture systems, yet many adoption questions remain amongst producers. This project aims to identify the perceived benefits and challenges of silvopasture adoption by producers. We developed and distributed an online survey to 12 states in the southeastern United States. The survey consisted of 14 questions addressing farm size, location, livestock, tree species, producers' interest, and environmental goals for adopting silvopasture systems. Producers identified income diversification, forage selection and soil fertility management as the main educational topics of interest. Results also showed that minimizing off-farm inputs and the potential to generate carbon credits from their land are the main environmental goals for introducing silvopasture. Results will be used to construct a decision-making framework for producers, and develop and disseminate educational resources (e.g., manuals, workshops) addressing silvopasture system establishment and management in the southeastern United States.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Progress and Status of the Data-Intensive Farm Management Project

Authors: *Robert Dunker (University of Illinois.edu)*; David Bullock (University of Illinois)*

DIFM (Data-Intensive Farm Management Program) uses precision agriculture technology, with researchers and farmers working together conducting large-scale, on-farm "checkerboard" field trials, gathering vast amounts of data on how crop yields respond to input application rates, field characteristics, and weather. DIFM is funded by a grant from the USDA Natural Resources Conservation Service Innovation Grants (CIG) On-Farm Conservation Innovation Trials. The goal of DIFM is to revolutionize farm management, working with farmers and crop consultants to implement scientific experiments on their own farms, enabling them to increase profits by making data-driven management decisions. The farmer conducted on-farm trials are part of a system that includes development of software that farmers and consultants can use to design and analyze data from their on-farm experiments.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Soil Health Management Systems on Orchards in the Central Valley

Authors: *Jeff Borum (East Stanislaus RCD)*; Trina Walley (East Stanislaus RCD); Rebecca Ryals (UC Merced); Alexia Cooper (UC Merced)*

The utilization of soil health management systems is an increasingly important topic in the agricultural industry, especially here in California. However, even with an emphasis on soil health practices over the past decade, California still possesses low rates of implementation and adoption of cover cropping, compost application, and other soil beneficial practices. According the Soil Health Institute's progress report on Adoption of Soil Health Practices, California is ranked at 43rd in the nation for adoption of soil health practices with only 4.8% of available farmland implementing the practices of no-till or cover crops. Federal, state, and local agencies, in addition to market-driven demand, have contributed to increased interest in the application of practices beneficial to the soil in order to address on-farm issues such as water quality, nutrient management, and pest control. These on-farm trials shall demonstrate that conservation practices implemented through the utilization of comprehensive soil heath management systems can aptly address these and a multitude of other issues. Several partners including American Farmland Trust, California Alliance for Family Farms, Project Apis m., and other RCDs will make up a well-rounded team with the ability to assess the environmental, economic, and social factors in reference to the implementation and adoption of these conservation practices and comprehensive systems. There will be 10 sites of approximately 100 acres in area, sampled over four years (five treatments and five controls). Additionally, 30 more sites shall have treatments of conservation practices performed at them for a total of 35 sites of total implementation across California's Central Valley.

In reference to soils analyses, the data that is to be collected at these ongoing field trials shall include, but not be limited to: soil organic matter dynamics; soil structural stability; microbial activity and diversity; and, available carbon- and nitrogen-pools. However, to get a more comprehensive assessment of the management systems being modified, soil moisture and pollinator monitoring have been added to the suite of analyses. In addition, after the sampling and processing of said samples is complete, statistical analyses shall be undertaken by ESRCD and UC Merced to help determine. ESRCD has partnered with American Farmland Trust to collect economic outcomes for case studies and Community Alliance with Family Farmers to collect social outcomes for documenting change in adoption of soil health practices. Data sets on California soils are extremely limited, and these on-farm trials would add to a nearly non-existent data bank. Through collaboration on local, state and national level makes the project a full spectrum project will be possible over a 5-year project period.

This poster shall serve as a mid-project summary, which will include interesting and significant trends found during research of the aforementioned mother trials.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Solar Corridor Cropping System: An Emerging Climate-Smart Agricultural Practice

Authors: Tunsisa Hurisso (Lincoln University-Missouri)*; Tim Rienbott (UMC South Farm Research Center)

The Solar Corridor Cropping System (SCCS) is a novel planting arrangement and method that can improve crop growth and yield efficiency and addresses a pressing concern in the agriculture sector – the need for sustainable and climate-resilient farming practices. The SCCS is pioneering a new era of agricultural production, driven by the ambition to maximize land use, promote soil health, enhance biodiversity, and combat climate change. Compared to conventional corn/soybean production where less than 60% of available sunlight is intercepted, primarily in the upper leaf canopy, the SCCS offers a new paradigm that aims to intercept and use more than 90% of incident sunlight, efficiently trap CO2, and produce a high-protein secondary crop (or "floor crop"), enhancing farmer profitability. This is accomplished by growing high-energy crops in wide-row widths to provide a "solar corridor" in which a lower stature "floor crop" is planted. We hypothesize that growing high-energy grain crops alongside high-protein forage crops for year-round grazing not only benefits livestock health and productivity, but also holds the key to a more sustainable and resilient future for farming while simultaneously making farming more accessible for all. Forage yield and forage quality, soil carbon sequestration, soil health impact, and profitability of SCCS-based alternative grazing strategy are being examined at Lincoln University of Missouri as well as University of Missouri-Columbia under both organic and non-organic settings. Preliminary results from the study will be covered in a poster presentation at the conference.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Using 3-D Imaging to Map Cover Crop Biomass Predictions in Cereal Rye (Secale Cereale L.)

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

Cover crops are an important tool for weed control. They suppress weed germination and emergence physically through a mulching effect. Estimating cover crop biomass production is crucial for predicting their weed suppression ability. This study used ground-based Structure-from-Motion (SfM) to estimate biomass in cereal rye (***Secale cereale*** L.), and mapped biomass predictions on a field scale with kriging. Videos were collected with a GoPro camera over 4 cover crop fields in North Carolina just before termination in spring 2023. Biomass and crop height were measured in quadrats (n=80) in each field. SfM was used to generate 3-D point clouds from the videos corresponding to each sampling quadrat. A predictive model was used to estimate biomass in each quadrat based on point cloud pixel density and crop height. Predicted and measured biomass were linearly related (r^2=0.713) through biomass levels of 9,000 kg ha^{-1}. Field maps of predicted and measured biomass generated by kriging and spatial autocorrelation showed similar distributions of high and low biomass areas. Measured biomass data were spatially correlated within 5.4 to 42.2 meters, and predicted biomass data were spatially correlated between 3.4 to 12.0 meters, depending on the field. Fields with the most pronounced patchiness had the most spatial correlation, and the closest match between predicted and measured biomass. This method can potentially be used by growers to nondestructively map crop biomass and identify areas that are be more likely to experience weed pressure.

Track: 2024 General Conference Theme

Subject: CIG Showcase

Water Quality Assessment Under Wireless Soil Moisture Sensor-Based Irrigation Scheduling System in South Carolina

Authors: *Udayakumar Sekaran (Oregon State University)*; Jose O Payero (Clemson University); Jemila Chellappa (University of Idaho)*

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: 2024 General Conference Theme

Subject: CIG Showcase

Poster Number 43

Illuminates Agricultural Nitrate-N Fate in the CEAP Choptank River Watershed

Authors: *Dylan Owen (USDA ARS); Greg W McCarty (USDA ARS)*; Cathleen J Hapeman (USDA-ARS); W. Dean Hively (USGS); Clifford P. Rice (USDA-ARS, Beltsville, Systainable Agricultural Systems Lab)*

Despite a plethora of research efforts and nutrient management strategies applied to the Chesapeake Bay watershed for nearly a century, water impairment continues to be an issue. A major concern is non-point source pollution from agricultural nitrate. However, a barrier to understanding the relationship between land management and water quality improvement is lag time in watershed response, groundwater transport dynamics and variability, and uncertainty in management practice effectiveness. While previous research has independently either analyzed nutrient trends to determine effectiveness of nutrient management or characterized watershed lag time it has not considered these two topics in unison or focused them on agriculture. Additionally, when watershed lag time is discussed, it does not take into account the unique hydrology of croplands. From 2007 – 2019 water samples were measured for both nitrate and MESA (a metabolite of the commonly used cropland herbicide, Metolachlor) from 18 subwatersheds of the Choptank basin. By utilizing the uniqueness of MESA as a land use specific conserved transport analogue of agricultural nitrate, this research illuminates nitrate dynamics and watershed variability. In addition, the long-term monitoring of these sites will assist in characterizing the groundwater mixing rate and the replacement rate of older water within the system. The improved understanding of nitrate fate in complex agricultural watersheds will be utilized in SWAT+ modifications and will lead to improved management strategies for reduction of agricultural nitrate export to sensitive aquatic ecosystems.

Track: 2024 General Conference Theme

Subject: CIG Showcase

A County-Specific Tool for Evaluating the Impact of Irrigation on Soil Water, Crop Water Use, and Crop Water Stress in South Carolina

Authors: *Jose O Payero (Clemson University)**

Irrigation scheduling depends on local weather conditions. In South Carolina, there is a lack of easy-to-use tools to facilitate accessing, compiling, analyzing, visualizing, and transforming local weather data into valuable information to help farmers make more accurate planning and day-to-day Irrigation scheduling decisions. Therefore, the objective of this study was to develop a user-friendly online tool to evaluate the impact of irrigation and other factors on daily and seasonal soil water, crop water use, and crop water stress based on local weather data for South Carolina, USA. An interactive online tool called IrrigApp (https://etcman.shinyapps.io/IrrigApp/) was developed using the Shiny R package. IrrigApp uses county-specific historical grass-reference evapotranspiration (ETo) and rainfall data to calculate daily crop evapotranspiration and conduct a daily soil water balance using user-specified options, showing results in graphical and tabular formats. This presentation will explain how the system was developed and will illustrate its functionality by providing sample outputs using simulations for cotton grown under dryland and irrigated conditions. IrrigApp provides an easy way to visualize how seasonal and daily changes in weather conditions affect soil water, crop water use, and crop stress. It also facilitates visualizing the impact of timing and amount of irrigation applied.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Assessing Corn Response to Cover Crops and Nitrogen Fertilization in a No-Till, Three-Year Rotation in Northeast Kansas

Authors: *Alexis L Correira (Kansas State University)*; Peter Tomlinson (Kansas State University); Kraig Roozeboom (Kansas State University); Jessica Grunberg (Kansas State University); DeAnn Presley (Kansas State University)*

As industry initiatives and government programs begin funding and incentivizing climate-smart agricultural practices, more farmers in the great plains region may be interested in incorporating cover crops into their rotations. Annual yield data can aid in understanding how cover crops impact cash crop productivity in this region. A long-term cover crop experiment in northeast Kansas was established in 2007 based on a wheat – corn – soybean rotation to determinate the effect of cover crops and nitrogen (N) rates on subsequent crop growth and yield. Treatments included different cover crops (cereal rye, crimson clover, a mix of cereal rye and crimson clover, and a diverse seven species mix) and control treatments (chemical fallow, double-crop soybean), planted in late summer after wheat harvest, and five N rates (0, 40, 80, 160, 240 lb/ac). Yield responded differently across cover crops treatments, nitrogen rates and years. In both the 2021 and 2022 growing seasons, corn after chemical fallow and double-crop soybeans had the highest yields with lower N rates (80 and 160 lb/ac), and corn following cereal rye and the cereal rye-crimson clover mix had the lowest yields overall. Nitrogen fertilizer replacement value of each cover crop treatment and double-crop soybeans were determined by solving the quadratic equation model of the chemical fallow treatment yield response to nitrogen fertilizer application rate. These replacement values were negative for most cover crop treatments, with values for the double-crop soybean being the least negative. Overall, nitrogen availability for plant uptake was reduced by the presence of a cover crop, and additional applied nitrogen was necessary for these treatments to reach baseline levels. Decreased precipitation during critical growing periods in 2022 exacerbated the negative yield response following the cereal rye cover crop monoculture and mix compared to 2021. Incorporating cover crops before corn can be done in Kansas, but additional nitrogen may need to be applied to recover what was lost from cover crops. Moisture is also a concern in this region, and cover crops can take up early season moisture leaving little for the germination of the cash crop in a dry year. Alternatively, a double-crop soybean would minimally impact subsequent corn yields and may offer both ground cover and an additional cash crop between wheat harvest and corn planting. In conclusion, cover crops may be implemented in northeast Kansas, but producers will need to consider additional N inputs and current moisture conditions when deciding whether or not to plant covers in a given year.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Assessing the Impact of Trees in a Temperate Agroforestry System on Soil Organic Carbon Accumulation

Authors: *Cecilia Albert-Black (University of Tennessee Knoxville)*, Sindhu Jagadamma, Debasish Saha, Jennifer Franklin*

Restoring the SOC pool is important to improve soil health and increase the climate resiliency of agricultural systems. Agroforestry systems (AFS), which integrate woody perennials in the same agricultural land with crops and/or animals, tend to accrue more soil organic carbon (SOC) compared to cultivated land and pastures. This is attributed to the abundant and continuous supply of organic matter inputs via above-ground plant litter and below-ground root turnover and exudates from trees. Most research on SOC of AFS has focused on tropical/subtropical regions, thus temperate AFS are largely understudied but of great importance as this land management is implemented globally to improve the climate resiliency of agroecosystems. Therefore, to broaden our understanding of the temporal and spatial extent AFS contribute to the SOC pool in temperate regions, this project studied a silvopasture AFS in Tennessee that included Chinese chestnut trees with an understory of cool-season dominant grasses and rotationally grazed sheep. We conducted a mixed model analysis of variance to examine the effect of three fields, two tree ages (4 and 7 years old), three distances from the tree base (0.5, 2, 15 m pasture only), and three soil depth increments (0-10, 10-30, 30-60 cm) on total SOC stock and the following SOC fractions: microbial biomass carbon, water-extractable organic carbon (WEOC), permanganate oxidizable organic carbon (POXC), particulate organic carbon, and mineral associated organic carbon. From preliminary statistical analysis, SOC stocks were significantly higher closest to the more mature trees (75 Mg C ha-1 compared to 59-62 Mg C ha-1 in the other soils), suggesting trees exert more impact on SOC under their canopy as they mature. Additionally, labile C fractions were most abundant closest to trees followed by the pasture system, suggesting SOC dynamics are dampened in the area between the trees and pasture possibly due to fewer SOC inputs, competition of soil resources between trees and grasses, and/or high traffic by grazing sheep. Though analyses are still ongoing, this study will contribute to our rudimentary understanding of the spatial and temporal impact of trees in a temperate-region AFS on SOC. This will pave the way for other studies to investigate the extent and distribution AFS can contribute to restoring the SOC pool in other suitable climate regions to increase the resiliency of global agroecosystems as we continue to adapt to a changing climate.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Automating the Application of Water and Nitrogen for Cotton Production Using a Center Pivot

Authors: *Javad Alavi (CLEMSON UNIVERSITY)*; Jose O Payero (Clemson University); Tom Owino (CLEMSON UNIVERSITY)*

The efficient application of water and nitrogen (N) fertilizers is vital for the long-term economic, and environmental sustainability of agricultural production. Insufficient applications of these crop inputs may lead to reduced crop yields, whereas excessive applications might increase production costs and result in adverse ecological impacts. As a fundamental element of climate-smart agriculture, soil moisture, and NDVI sensors could be employed to automate and optimize the application of water and N-fertilizer in agriculture. The objective of this investigation was to develop an automated system retrofitted on an existing center pivot for combined control of site-specific water and N applications. A water and N automation system for a center pivot was developed using a wireless sensor network driven by Arduino microcontrollers at the Edisto Research and Education Center (EREC) in Blackville, South Carolina. The initial setup and testing of the system were conducted during a field experiment with cotton in 2023. The experiment consisted of a split-plot design to evaluate five irrigation treatments and three N treatments using five replications. Soil moisture sensors were installed at three depths in the irrigation plots. Five NDVI sensors were installed on the center pivot to estimate crop N status in different areas of the field as the pivot rotated. The soil moisture and NDVI data were collected and transmitted to a central receiver using a wireless sensor network driven by Arduino microcontrollers using LoRa radio communication. Based on the sensor data, the central receiver was used to control solenoid valves to apply water and N when and where needed. All the equipment and sensor setups for the field experiment were constructed and initially tested in 2023, showing promising results. Field experiments to improve and fine-tune the automation system will continue in 2024.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Carbon Dioxide Emission from Regenerative Cotton Cropping Systems in the Texas Plains

Authors: *Nicholas F Boogades (Texas A&M AgriLife)**

Carbon in agriculture systems is primarily cycled through photosynthesis and soil respiration. Carbon sequestration occurs when carbon inputs are greater than carbon losses and can be achieved by increasing photosynthetic inputs, reducing carbon losses through respiration or a combination of the two. Carbon sequestration can have positive impacts on cropping systems by increasing water holding, providing soil stability and a slow-release nutrient source. Cotton (Gossypium hirsutum) cropping systems in the semi-arid Texas Plains receive a limited amount of rainfall meaning carbon inputs in conventionally tilled, continuous cotton systems are low due to limited net primary production. Regenerative agriculture practices, which could include cover crops, crop rotation with cotton and reduced tillage increase carbon input by increasing plant biomass production and may benefit carbon sequestration. However, the effect of regenerative practices on carbon dioxide emissions due to soil respiration is unknown. Carbon dioxide emissions will negatively impact sequestration potential because they are a direct loss of soil carbon to the atmosphere. Here, we investigated the impact of three cotton cropping systems on soil carbon dioxide emissions in Lamesa, TX. Cotton with rye cover crop and reduced tillage increased carbon dioxide emissions compared to the regional standard practice of continuous cotton with winter fallow and conventional tillage, while cotton-wheat-fallow with reduced tillage was not different from the standard practice. Reduced emissions compared to the cover crop system and similar carbon inputs could make the rotation a more reliable practice for increasing carbon sequestration.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Conservation and Conventional Production Systems in Midsouth Cotton: A Six-Year Study Comparing Irrigated and Rainfed Management on Production, Runoff Water Quality, and Greenhouse Gas Emissions

Authors: *Tina Gray Teague (Univ of Arkansas System Division of Agriculture & Arkansas State Univ)*; Michele Reba (USDA-ARS); Arlene Adviento-Borbe (USDA-ARS Delta Water Management Research Unit); Geoffrey Payne (USDA-ARS Delta Water Management Research Unit); Anna Pieri (University of Arkansas System Division of Agriculture); N. Ray Benson (Arkansas State University)*

Midsouth cotton producers who manage farms with sandy soils commonly employ some type of cover crop tactic along with conservation tillage to reduce risks of cotton seedling damage from blowing sand and wind. In this poster presentation we will present results from a 6-year, on-farm study at the Judd Hill Foundation Farm in NE Arkansas, where we compared a conservation and conventional production system with and without irrigation. Our findings successfully demonstrated benefits of the conservation system which included a cereal rye winter cover crop and reduced tillage system. We observed no maturity or yield penalty for addition of conservation practices compared to conventional production practices. Yield benefits with the conservation production system were apparent in rainfed production in low rainfall years. Response to irrigation was dependent on precipitation; however, yields in rainfed treatments tended to be higher in conservation treatments in 2020, 2021, 2022 and 2023. Watermark sensors were inconsistent showing variation in soil moisture in the sandy soils. Early winter cover crop termination timing is critical to successful adoption of cereal winter cover crops in Midsouth cotton production systems. We followed Arkansas Extension recommendations that winter cover crops for cotton production be terminated using herbicide at least 3 weeks prior to planting cotton, and with this approach, pest insects were not a factor in production. Cotton variety selection improved crop performance in year 5 and 6 when we shifted from Phytogen 300 W3FE to DP20B3XF. In-season, plant montioring using the COTMAN system provided documentation of plant growth response with height, nodal development, and fruit retention measures as well as a helpful gauge of late season maturity. Significant improvements in runoff water quality were associated with adoption of conservation practices compared to the conventional system. These data will be presented as well as findings from greenhouse gas monitoring comparing the two systems in years 4-6.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Covering Ground: Enhancing Soil Health through Interseeding in Late-Season Vegetables

Authors: *Gladys Adu Asieduwaa (University of Maine)*; Rachel Schattman (University of Maine); Jason Lilley (University of Maine Cooperative Extension)*

In my research, I address challenges faced by vegetable farmers in Maine and northern New England due to short growing seasons, limiting the time for winter cover cropping and risking erosion, nutrient leaching, and weed growth in bare soil. Results from a preliminary survey conducted by the University of Maine Extension about cover cropping practices on Maine showed 77.8% of respondents struggle with "late season cash crops coming out too late," hindering cover crop planting. To address this challenge, I am conducting replicated field trials and a sociological survey over a three-year span (2022-2024), to investigate best management practices for interseeding cover crops into standing-late-season vegetables and the logistical constraints related to the adoption and utilization of interseeding cover crops among Northeast farmers. Factors investigated include seeding timing, methods, and cover crop species, categorized into Trial A (timing and seeding methods) and Trial B (cover crop species). I hypothesize that optimal interseeding at specific growth stages will yield high cover crop biomass without harming crop yield, incorporating seeds into the soil will optimize germination and control weeds, and low-biomass cover crops will minimize nutrient and water competition.

The preliminary findings from 2022 affirm the hypothesis that optimal interseeding at specific growth stages leads to substantial cover crop biomass without adversely affecting crop yield. The analysis of data from the second-year field trial is currently underway and will be completed before the poster presentation to enhance the robustness and reliability of the results. However, the sociological study is scheduled for fall 2024. In the field trials, I use a split-plot factorial design for Trial A, investigating the relationship between treatments and dependent variables using R (version 4.2.2, 2022). For Trial B, I utilize a randomized complete block design. Data analysis involves one-way repeated measures MANOVAs and chi-square or ANOVA tests for data averaged over the growing season.

This study addresses the critical need for sustainable cover cropping practices, offering evidence-based insights. Sociological findings will provide valuable adoption challenges insights. I plan to develop evidence-based recommendations for interseeding cover crops, collaborating with farmers, and disseminating findings through extension programs. The poster presentation targets a diverse audience, including farmers, growers, professionals, researchers, students, educators, extension officers, and scientists. It encourages individuals interested in conservation, climate-smart agriculture, cover cropping, soil health, and sustainable agriculture, along with policy makers and stakeholders supporting sustainable farming practices, to attend, providing informative content relevant across agriculture-related topics.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Effects of Perennial Cover Cropping on Soil Moisture and Temperature in Almond Orchards

Authors: *Kelsey Fenn (University of California, Davis)*; Mallika A Nocco (University of Wisconsin-Madison); Alyssa DeVincentis (Formation Environmental); Andrew Gal (University of California, Davis); Patrick Makiri (University of California, Davis); Samuel Sandoval Solis (University of California, Davis); Cristina Lazcano (UC Davis)*

While cover cropping is a well-established conservation practice for improving soil health, adoption rates among orchard growers are low in part due to concerns over cover crops competing for water resources. Oakville Bluegrass, a new hybridized perennial grass, goes dormant in late spring and may be ideal for orchard systems by circumventing common challenges. This research investigates the impact of the novel cover crop on soil temperature and water storage dynamics in orchard alleys. We implemented a trial of Oakville Bluegrass on a young almond orchard in a block design to assess the effects of cover cropping compared to conventional management with residual vegetation. Continuous soil moisture and temperature data were collected using dielectric sensors at 15 and 30 cm depths at the edge of the alley and the center of the alley under both management practices. At peak cover crop growth, we measured the area of the seeded alley covered by Oakville Bluegrass to assess cover crop establishment. We hypothesize that cover cropping will not deplete soil moisture compared to conventional management. Cover crops will allow soils to absorb and retain more water during winter rainfall events, providing more soil moisture at the beginning of the almond growing season. Fractional soil moisture is calculated as the amount of soil water remaining at the start of the irrigation season compared to when the field was at peak saturation over the winter. This measurement is crucial for growers because it helps determine when they should commence irrigation based on the remaining soil moisture at the beginning of the almond growing season. We expect cover cropping to have lower soil temperature than bare ground management from canopy cover and residue input. Cover crops can help mitigate abrupt changes in soil temperature and reduce evaporation over the hot summer seasons in the California Central Valley. These results will help clarify perceptions of cover crop water use, addressing concerns that often lead orchard growers to maintain bare ground management. We will continue to assess water storage dynamics of this cover crop by measuring soil water retention curves and calculating changes to plant available water capacity. Potential water storage benefits from Oakville Bluegrass could make this conservation practice more viable for orchard growers who are hesitant to cover crop because of water usage.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Impact of Climate Change on Climate-Smart Agriculture: Soil Carbon and GHG Mitigation Potentials

Authors: *Xiuying Wang (Agoro Carbon Alliance)*; Shaoqing Liu (Agoro Carbon Alliance); Caden Zhao (Stevenson High School); John .Shanahan (Agoro Carbon Alliance)*

Climate-smart agricultural practices like cover cropping and reduced/no-tillage are lauded for their potential to augment Soil Organic Carbon (SOC) sequestration and diminish greenhouse gas (GHG) emissions. Nonetheless, there is a significant gap in understanding the long-term effects of future climate change on the efficiency of these practices and their overall net GHG impact at the field scale. Our study employs the DayCent model, calibrated and validated via a Bayesian approach and k-fold cross validation using extensive, peer-reviewed long-term field experimental data from the US. We investigate the impact of three climate scenarios—recent climate data recycling, HadGEM2_ES365_RCP45, and HadGEM2_ES365_RCP85—on cropland carbon and nitrogen dynamics through 2099. The analysis incorporates various climate-smart management strategies, including residue retention, cover cropping, and no-tillage, applied singularly or in combination. These strategies were based on management treatments from selected experimental sites, maintaining constant land use under the stipulated climate conditions (climate forcings starting from 2021). The uncertainty of SOC predictions is quantified using a Monte Carlo approach. Preliminary findings indicate that while recent climatic changes may favor the role of carbon farming in soil carbon sequestration, this benefit is potentially jeopardized under high-emission scenarios. These future scenarios might not only lower soil carbon storage capacity but could also escalate N2O emissions. This study highlights the urgent need for aggressive emission reduction to prevent negative feedback loops, emphasizing the importance of proactive climate change mitigation and adaptation strategies in agriculture.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Improving Almond Orchard Resilience to Climate Change with Deep Root Irrigation

Authors: *Andrew Gal (University of California, Davis)*; Mallika A Nocco (University of Wisconsin-Madison); Nicolas Bambach (USDA-Agricultural Research Service); Mikey Boyle (University of California, Davis); Alyssa DeVincentis (Formation Environmental); Kelsey Fenn (University of California, Davis); Patrick Makiri (University of California, Davis); Andrew McElrone (USDA-Agricultural Research Service)*

California produces an overwhelming majority of specialty crops in the United States (US), including nearly 100% of the US and 80% of the global supply of almonds. Farmers in the region are now faced with increasingly difficult climate-related challenges, such as drought and extreme heat, all while trying to meet the needs for sustainable agricultural management. Recent advances in irrigation systems, specifically subsurface drip irrigation, may prove to be a viable alternative to conventional microirrigation systems. Subsurface drip in almonds could provide advantages such as early-on root depth expansion to mitigate windfall, delivering nutrients directly to the root zone, and minimize surface evaporation. However, there are currently no comprehensive guidelines for implementing this new technology. The goal of this project is to quantify water and energy fluxes associated with deep root irrigation (DRI) within the soil-plant-atmosphere continuum at levels ranging from the soil subsurface to whole-orchard scale and incorporate findings into remote sensing of evapotranspiration (ET) models while addressing the dilemma of "when, where, and how much to irrigate?"

This study took place on a 36-ha commercial almond orchard in California's San Joaquin Valley. DRI was installed on the northern half (18-ha) of the orchard in spring 2023 while the southern half remained on double-line drip irrigation. The site was heavily instrumented with four micrometeorological towers equipped to monitor surface energy fluxes based on either the eddy covariance or surface renewal methods. Twelve soil sensor transects were installed throughout the orchard to continuously monitor soil moisture and temperature responses to DRI vs. conventional drip line irrigation. DRI and double-line drip zones were irrigated independently; irrigation scheduling was based on tree stress using stem water potential (SWP) measurements and ETa from the eddy covariance tower. SWP and gas exchange measurements were paired with neutron hydroprobe readings to address two key challenges: 1) quantify tree stress responses to irrigation and 2) understand the soil wetting pattern of DRI. Simultaneously, high-resolution thermal and multispectral drone imagery was collected alongside these readings to map actual ET (ETa) at a tree-scale resolution. Preliminary results from this research indicate that there can be significant overall water savings with DRI when it is applied in shorter, more frequent irrigation intervals and we can detect tree-level responses to irrigation, which can ultimately lead to more accurate and better-informed, climate-smart irrigation management decisions.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Incentivizing Climate Smart Practices in South Carolina

Authors: *Bhupinder Singh Farmaha (Clemson University)*; Matthew Cutulle (Clemson University); Brian Ward (Clemson University); Liliane Silva (Clemson University); Nathan Smith (Clemson University); Felipe Silva (Clemson University); Anastasia Thayer (Clemson University); Kelly Flynn (Clemson University); Paula Agudelo (Clemson University)*

South Carolina agriculture faces unique challenges with soils that are highly degraded. Most of these soils have a subsurface compacted zone (hardpan) limiting root penetration and extremely low water holding capacity (less than 0.1 inch/inch) predominantly due to sandy texture and low organic matter content (< 1%) . Even short drought periods in these conditions can reduce crop yields and impair the climate resilience of farming systems. The use of climate-smart practices such as cover crops, reduced tillage, mulching, and addition of recycled organic materials are increasingly popular among to increase nutrient cycling and available water holding capacity with improved organic matter content and better soil aggregation. The adoption of reduced tillage and cover crops across farming systems led to significant changes in the weed community in the agricultural fields. The overarching goal of this state-wide project is to provide incentive payments to farmers to increase adoption of field-validated and proven climate-smart practices across farming systems. Currently, we have 42 peanut producers, 93 leafy greens producers, and 114 forage for beef farmers enrolled in incentive programs. In the project, we are systematically collecting greenhouse gas emissions data and soil samples at various interval throughout the grant cycle. This approach will allow us to assess temporal changes in the soil health, and study the impact of climate smart practices on crop yields, weed species, and broader impacts of selected climate-smart practices on on both environment and farm profits.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Network Strategies and Studies to Advance Science for Climate-Smart Agriculture in the LTAR Network

Authors: *Lindsey Witthaus (United States Department of Agriculture - Agricultural Research Service)**

Agricultural systems and producers are constantly facing a variety of challenges and stressors, but perhaps the most universal and persistent of them all is climate change. Since its creation, the United States Department of Agriculture (USDA) Long-Term Agroecosystem Research (LTAR) Network has identified climate change mitigation and adaption as a focus area. Stakeholders who partner with LTAR scientists have requested greater emphasis on recommended strategies for climate change adaptation and mitigation. The LTAR "Science for Climate-Smart Agriculture" (CSA) strategic initiative exists to identify agronomic innovations to improve the resiliency of cropland and grazing land ecosystems to climate change, to identify and test climate change mitigation strategies to increase carbon storage and reduce greenhouse gas emissions, and to facilitate model development to predict agroecosystem responses to future climates. Given the national scope of the LTAR network, adaptation strategies are needed for drought stress, flooding and overly saturated soils, plant and animal heat stress, pest pressure, and identification of forward-thinking cropping regimes. Through research enveloped in the CSA initiative, the LTAR Network is poised to become a trusted source for assessing agronomic interventions that promote resilience and mitigation against climate change. Network strategies and preliminary studies will be presented with respect to measurement of greenhouse gases from agricultural systems, evaluation of net carbon storage and global warming potential of practices, identification of climate resilient management practices, and climate impact modeling. We hope to engage in a conversation with other researchers to share best practices and ideas for advancing Science for Climate-Smart Agriculture and strengthening international collaborations on this critical issue.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Soil Hydrological Responses to Stacked, Regenerative Management in California Vineyards

Authors: *Nall I Moonilall (University of California, Davis)*; Mallika A Nocco (University of Wisconsin-Madison); Sarah Brickman (University of California, Davis); Raymond Reis (University of California, Davis); Ivy Israel (University of California, Davis); Zachary Orlando-Milbauer (University of California, Davis); Sangeeta Bansal (California State University, Fresno); Amelie Gaudin (University of California, Davis); Cristina Lazcano (UC Davis)*

The southwest U.S. produces many of the nation's high-value crops. Many of the region's irrigated perennial agricultural systems are experiencing increased vulnerability due to a changing climate, weather whiplash, and depleted groundwater resources. Adapting soils within these agroecosystems through enhancing soil physical health could increase system resiliency and buffer against climate extremes. Changes in soil functionality requires grower adoption of regenerative soil management practices, like conservation tillage/ no-tillage, cover cropping, organic amendment inputs, crop rotations, and crop-livestock integration. Individually, these practices have been shown to have promising impacts on the soil physical environment. However, stacking these practices could further accelerate positive changes in soil health and functionality, especially for promoting greater water infiltration, transmission, and storage in the vadose zone. Knowledge gaps exist on what the most effective combinations are and what the magnitude of change in soil water distribution and dynamics will look like due to changes in soil structure caused by these practices. This study aims to quantify soil hydrological responses under combinations of regenerative practices adopted in wine grape agroecosystems in California. Specifically, we will (1) assess water infiltration, transmission, and storage dynamics in the rooting zone of the system where management occurs, and (2) determine inter-relationships between these agrohydrological properties and other soil structural and carbon properties. We will assess key soil hydrological properties using paired vineyard blocks across several sites in Napa County, California. Soil physical health indicators analyzed in this study include water infiltration, saturated hydraulic conductivity, and soil water retention curves. We expect that preliminary results will demonstrate higher water infiltration rates, greater saturated hydraulic conductivity, and more plant-available water in those vineyard soils with greater soil conservation management practices adopted for longer periods of time. We expect that stacking soil conservation practices can assist in improving agrohydrological functioning in vineyards through building adaptation and mitigation against droughts and floods stemming from a changing climate.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Soil Water Conservation in Semi-Arid Regenerative Agricultural Cotton Systems

Authors: *Christopher Cobos (Texas A&M AgriLife Research)**

Depletion of groundwater resources in the Southern High Plains (SHP) of Texas drives a need for more regenerative agricultural practices in semi-arid regions. Here we define regenerative agriculture in the context of the SHP as the continued capacity of agricultural systems to function in a changing climate that supports soil health, communities, economic output, environmental sustainability, and resiliency to the outside threats of those outcomes. Within the capacity of this definition, our core values for regenerative agriculture are to 1) maintain economic viability of the system, 2) optimize soil water conservation, 3) minimize soil disturbance, 4) maintain soil surface coverage, 5) incorporate a living root in the soil for as long as possible, and to 6) minimize the global climate change effects derived from agricultural practices. Regenerative practices relevant to the region and associated core values include the implementation of cover crops, crop rotations, conservation tillage, and livestock integration. Cover crop termination timings can have large impacts on the amount of soil coverage, nutrient availability, and stored soil moisture in a system. Producers in semi-arid regions must gamble the possibility of increased soil infiltration and reduced soil water evaporation against the potential of decreased soil moisture; in the SHP, success is dependent on irrigation capacity and precipitation. Optimizing termination timings for semi-arid regions and in deficit-irrigation/dryland systems is critical for the success of regenerative practices across this large agricultural region. Small unmanned aerial systems (sUAS) can be used to observe plant physiological parameters across large areas. This data in tandem with ground-truthed soil parameters and plant characteristics can be integrated into crop simulation models to create high-throughput diagnostic tools to determine the sustainability of regenerative agricultural practices in semi-arid regions. sUAS was used to collect field images via multispectral lenses, capturing 6 separate bands of light per photo (RGB, red [630-690 nm], green [510-580 nm], blue [450-510 nm], red edge [670-760 nm], and NIR [700-1,200 nm]). Flights were conducted at or as close to solar noon as permissible with a minimum vertical and horizontal image overlap of 80% to ensure total mapping area coverage. Flights were taken at 8, 6, 4, and 2 weeks from cotton planting and at key cotton growth stages (pinhead square, full bloom, and first cracked boll). Volumetric water content (θ) was determined at soil depth (0-10 cm, 10-30 cm, 30-60 cm, and 60-90 cm) at each 2-week timing interval from cotton planting (8 weeks from cotton planting, 6 weeks, 4 weeks, and 2 weeks) and at cotton planting (0 weeks; 5/16/23). Year one of the study showed no significant differences in cotton lint yield between treatments within irrigation level.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Illuminates Agricultural Nitrate-N Fate in the CEAP Choptank River Watershed

Authors: *Dylan Owen (USDA ARS); Greg W McCarty (USDA ARS)*; Cathleen J Hapeman (USDA-ARS); W. Dean Hively (USGS); Clifford P. Rice (USDA-ARS, Beltsville, Systainable Agricultural Systems Lab)*

Despite a plethora of research efforts and nutrient management strategies applied to the Chesapeake Bay watershed for nearly a century, water impairment continues to be an issue. A major concern is non-point source pollution from agricultural nitrate. However, a barrier to understanding the relationship between land management and water quality improvement is lag time in watershed response, groundwater transport dynamics and variability, and uncertainty in management practice effectiveness. While previous research has independently either analyzed nutrient trends to determine effectiveness of nutrient management or characterized watershed lag time it has not considered these two topics in unison or focused them on agriculture. Additionally, when watershed lag time is discussed, it does not take into account the unique hydrology of croplands. From 2007 – 2019 water samples were measured for both nitrate and MESA (a metabolite of the commonly used cropland herbicide, Metolachlor) from 18 subwatersheds of the Choptank basin. By utilizing the uniqueness of MESA as a land use specific conserved transport analogue of agricultural nitrate, this research illuminates nitrate dynamics and watershed variability. In addition, the long-term monitoring of these sites will assist in characterizing the groundwater mixing rate and the replacement rate of older water within the system. The improved understanding of nitrate fate in complex agricultural watersheds will be utilized in SWAT+ modifications and will lead to improved management strategies for reduction of agricultural nitrate export to sensitive aquatic ecosystems.

Track: 2024 General Conference Theme

Subject: Climate-Smart Agriculture

Ranch Economics of Lesser Prairie Chicken Conservation

Authors: *John Tanaka (University of Wyoming Agricultural Experiment Station); Kristie Maczko (Sustainable Rangelands Roundtable - University of Wyoming)*; Jessica L Windh (University of Nebraska - Lincoln)*

The lesser prairie chicken (LPC) is being considered for threatened and endangered species consideration by the U.S. Fish and Wildlife Service. Approximately 95% of LPC habitat is in private land ownership. Conservation is thus focused on these lands with funding potentially supplied through Natural Resources Conservation Service (NRCS) conservation programs, most notably through the Environmental Quality Incentives Program (EQIP). Under EQIP, practice payments are made to landowners to implement planned conservation practices. Trees and uniform grazing are viewed as two of the main threats to the lesser prairie chicken. This project attempts to estimate the economic impact of implementing lesser prairie chicken conservation practices on small and large representative ranches in 4 Major Land Resource Areas (MLRA). Models were developed in the General Algebraic Modeling System (GAMS) as recursive linear programs and run for 20 years. Random precipitation patterns for each MLRA and cattle price sets were used. Baseline models were developed to balance forage with average herd size. Conservation practice models that evaluated practices on all or half the rangeland area with the ranch paying 100, 25, or 0% of LPC conservation cost are compared to baseline models. Modeling shows that restoring LPC habitat on private ranches may or may not be profitable for the rancher. It depends on the size of the ranch, how much area needs treatment, forage response to removing trees, cattle prices, and how much of the conservation practice cost needs to be paid by the rancher. Removing trees and grazing heterogeneously are important considerations on ranches in the 4 MLRAs considered. Trees can be removed using herbicides followed by mechanical removal of the skeletons, chaining, or prescribed burning. In all cases, follow up treatment is necessary to remove trees missed in the initial treatment and to prevent reestablishment. Varied grazing intensities can be used to create heterogeneous habitat that the LPC prefer at different life stages. In all analysis scenarios and cattle prices, small and large ranches have higher household income (HI) when they pay 0% of the conservation practice cost, regardless of how much area is treated. The small and large ranches show a decrease in HI when the ranch pays 25% of the conservation cost. This is likely due to the high cost of the mechanical treatment and removal of the residue. We considered representative ranches in each MLRA based on enterprise budgets for each state. Because individual ranches vary greatly, results may not be directly applicable to every ranch in each MLRA. It is important to conduct an individual ranch analysis before a ranch opts to participate in LPC conservation. The rancher needs to determine if profit or household income or some combination is important to them. The basic framework used in this study can guide such an analysis for the rancher, NRCS, and other conservation professionals.

Track: 2024 General Conference Theme

Subject: Conservation Economics and Policy

Transitioning to Organic Farming: Enhancing Soil Health and Weed Control through the Implementation of Living Mulch and Grazing Methods

Authors: *Jerad Cater (North Carolina State University); Ekrem Ozlu (North Carolina State University)*; Alex Woodley (North Carolina State University); Miguel Castillo (North Carolina State University)*

The growing global population, combined with declining soil health in intensive production systems, necessitates the adoption of sustainable agricultural practices that yield comparable crop outputs. In order to compete with traditional systems, organic producers employ techniques such as crop rotation, grazing, and cover crops to enhance soil structure, fertility, weed control, and microbial biomass. Ongoing research attributes the use of cover crops to improvements in soil health, carbon sequestration, erosion prevention, and an augmentation of ecosystem services. Nonetheless, there is an existing need to measure the impact of intercropping clover as a living mulch within integrated crop-livestock systems across diverse climates in the United States. To address this gap, a 48-month collaborative study involving Washington State University, North Carolina State University, Oregon State University, and Rodale Institute is underway. NC State's Cherry Farm Station, representing the Southeast region, is employing a corn-soybean rotation on certified organic fields. The study encompasses treatments with crimson clover, kura clover, red clover, and white clover, each with and without cattle grazing. The assessment will elucidate the effects of various clover and grazing combinations on yield optimization, livestock performance, soil health, weed management, greenhouse gas fluxes, ecosystem services, and economic outcomes. The primary objective of this study is to enhance economically and environmentally sustainable organic production through innovative land management practices, benefiting producers, consumers, and the scientific community.

Track: 2024 General Conference Theme

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

A Data-Driven Irrigation Decision Support System for Irrigation Scheduling of Cotton

Authors: *Lisa Umutoni (Clemson University)*; Vidya Samadi (Clemson University); Jose O Payero (Clemson University)*

Agriculture faces increasingly severe and expanding competition for freshwater from other sectors. Smart irrigation systems, powered by continuous soil water monitoring and wireless communication networks, have the potential to enhance irrigation efficiency. A combination of weather, soil and plant sensors that offer real-time data to a decision support system presents an innovative platform for improving sustainability in irrigated agriculture. This work aims at leveraging data to enhance the irrigation decision making and scheduling process for cotton. A field experiment was conducted at Clemson University's Edisto Research and Education Centre on a cotton field irrigated by a lateral move irrigation system during the 2023 cotton growing season to acquire data needed to train a data-driven irrigation decision support model to learn the underlying relationship between soil moisture change, weather and crop water need and generate irrigation schedules that optimize water use. The experiment used a randomized complete block design to evaluate three irrigation treatments using four replications (12 plots). Weather variables, soil moisture, and above-ground biomass were measured. A soil moisture probe was installed in each plot to monitor hourly soil moisture from four depths in the crop root zone. Biomass samples were taken weekly to track plants' growth in each plot. The collected data is used to build an irrigation decision support system that will assist growers in making informed irrigation decisions. The system is anticipated to achieve a higher yield and minimize water losses to a significant extent.

Track: 2024 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

A Novel framework for Farm Irrigation Optimization via GPR-based Intelligent Multi-layered Subsurface Soil Moisture Assessment

Authors: *Himan Namdari (Worcester Polytechnic Institute)*; Majid Moradikia (Worcester Polytechnic Institute); Seyed Zekavat (Worcester Polytechnic Institute); Douglas Petkie (Worcester Polytechnic Institute); Radwin Askari (Michigan Technological University)*

This work introduces a novel framework for soil moisture estimation at different levels of root zones using ground penetration radar (GPR) data. The work offers a comprehensive approach for soil subsurface characterization at megafarms via supervised Machine Learning (ML) methods that need accurately labeled data for the training phase. Our framework comprises the following main stages. (1) We create a realistic labeled dataset based on soil texture and hydraulic profiles using gprMax software. gprMax is a powerful simulation platform based on Maxwell Equations and FDTD numerical modeling. (2) We validate the gprMax-generated data with real-world measurements from the SoilX field lab at Worcester Polytechnic Institute (WPI). (3) GPR-received signals naturally are large data strings computationally expensive for the supervised ML training phase. To reduce the size of the training dataset and improve estimation accuracy, we implement advanced data feature extraction techniques, including time-domain analysis and a feature extraction method based on Peak Extraction. (4) We demonstrate the application of our framework for soil moisture estimation through a comprehensive feature analysis. Our method offers significant improvements over existing techniques, providing a more accurate, efficient, and adaptable solution for soil moisture estimation in different soil compositions. This result is crucial for a soil moisture map, which can be utilized to optimize the farm irrigation model and, accordingly, water and soil mineral conservation. This approach considerably impacts smart agriculture and avoids rapid decline in the water table.

Track: 2024 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Drone-Based GPR Hardware Implementation and Data Acquisition

Authors: *Saeed Haghniaz Jahromi (Worcester Polytechnic Institute)*; Zhonghai Wang (Michigan Technological University); Majid Moradikia (Worcester Polytechnic Institute); Seyed Zekavat (Worcester Polytechnic Institute); Douglas Petkie (Worcester Polytechnic Institute); Ethan Reed (Worcester Polytechnic Institute); Nicholas Latsis (Worcester Polytechnic Institute); Joshua Thurber (Worcester polytechnic Institute)*

Ground Penetrating Radar (GPR) is increasingly recognized for its potential in the non-destructive evaluation of subsurface soil moisture, which is crucial for optimizing irrigation practices and enhancing wildfire prediction and management. Traditional GPR systems, being ground-based, suffer from slow data acquisition rates and limited access to various terrains. These challenges undermine their efficiency, particularly in urgent scenarios such as monitoring large agricultural areas and predicting wildfire ignition and spread.

This research introduces an innovative approach by presenting a novel hardware design for GPR that integrates seamlessly with drone-based systems, overcoming the limitations of conventional ground-based methods. By leveraging a portable power supply, processing unit, and data storage systems, which, in combination with a drone, enable rapid and extensive surveying of large and inaccessible areas, this approach facilitates a more timely and detailed assessment of subsurface conditions. Additionally, a novel methodology in software design is presented, specifically to tune the GPR waveform and power of the transmitting signals. This flexibility is crucial for adjusting to different soil compositions and conditions, significantly enhancing the quality of subsurface data collection. Furthermore, machine learning techniques are implemented on the processing unit to analyze the GPR signals, improving the interpretation of subsurface moisture content and soil characteristics. Our extensive dataset and experiments validate the impact of waveform adjustments on the quality of received signals. This machine learning integration allows for more accurate and nuanced soil characterization, contributing to better irrigation management and wildfire risk evaluation. The design integrates advanced features that support real-time ground analysis, generating an adaptive waveform, which is vital for the drone's operational efficiency during flight for extended scanning of large-scale farms.

The developed portable GPR system is tailored for drone integration, marking a significant advancement in remote sensing applications. This research underscores the synergy between drone technology and ground-penetrating radar, enhanced by machine learning, to address critical environmental and agricultural challenges.

Track: 2024 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Forecasting Daily Reference Evapotranspiration and Rainfall for Water Resources Conservation and Sustainable Agriculture

Authors: *Sayed Bateni (University of Hawai'i at Mānoa)*; Helaleh Khoshkam (University of Hawai'i at Mānoa); Mohammad Valipour (Metropolitan State University of Denver); Jinwook Lee (University of Hawaii at Manoa); Mehdi Jamei (University of Prince Edward Island); Jonathan Deenik (University of Hawaii at Manoa)*

The accurate forecast of reference evapotranspiration (ETo) and rainfall has a vital importance in optimal irrigation scheduling, irrigation system design and management, and efficient water resources management. In this study, we developed several novel artificial intelligence (AI) approaches to forecast ETo and rainfall.

In the first attempt, three stand-alone artificial intelligence (AI) models, namely Cascade Forward Neural Network (CFNN), Extreme Learning Machine (ELM), and Bagging Regression Tree (BRT) were used to forecast daily ETo. Thereafter, we combined the K-Best feature selection (KBest) and Multivariate Variational Mode Decomposition (MVMD) algorithms with the stand-alone models and developed three novel hybrid models (namely, MVMD-KBest-CFNN, MVMD-KBest-ELM, and MVMD-KBest-BRT) to predict ETo. All six models were trained and tested at twelve weather stations in California (USA) over 2003-2017 and 2018-2022, respectively. Input variables included solar radiation, air temperature, dew point temperature, vapor pressure, and relative humidity. The hybrid models performed significantly better compared to the stand-alone models. The MVMD-KBest-CFNN model produced the best results with the 12-site mean determination coefficient of 0.966, 0.960, 0.955, and 0.937 for 1, 3, 7, and 10-day-ahead ETo forecasts.

In the second attempt, we developed the wavelet long short-term memory (WLSTM), wavelet group method of data handling (WGMDH), and wavelet genetic algorithm adaptive neuro-fuzzy inference system (WGA-ANFIS) models to forecast multi-step (i.e., 1, 3, 7, and 10)-ahead daily ETo at 30 sites across the contiguous United States (CONUS). Solar radiation, maximum, minimum and mean air temperatures, and relative humidity were employed as inputs. We used daily meteorological data from 2005-2014 and 2015-2019 for training and testing phases, respectively. WLSTM outperformed the other models for 1-day-ahead ETo forecasting in terms of the 30-site mean RMSE of 0.541 mm/d. In contrast, WGMDH performed better than WLSTM and WGAANFIS for 3-, 7-, and 10-day-ahead ETo forecasting with the root mean square error of 0.636, 0.649, and 0.651 mm/d, respectively.

In the third attempt, we developed the WLSTM, WGMDH, and wavelet particle swarm optimization (WPSO)-ANFIS approaches to forecast the daily rainfall (i.e., 1-, 2-, and 3-day-ahead) at 28 sites located over the CONUS. We trained and tested different approaches with daily precipitation data from 1995-2014 and 2015-2019, respectively. The 28-site-average MAEs of 1-day-ahead rainfall forecasts from WLSTM, WGMDH, and WPSOANFIS were 0.65, 0.77, and 1.31 mm/d, respectively.

Finally, forecasted ETo and rainfall values were used in the CropManage irrigation tool. Results showed that using ETo and rainfall forecasts in CropManage improved its performance and further conserved water resources, lowered farmers' cost of water and labor through few irrigation events, and increased farmers' profit.

Track: 2024 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Measuring Farming Sustainability in the Fieldprint Platform

Authors: *Austin Pearce (Field to Market: The Alliance for Sustainable Agriculture)*; Sydney Mucha (Field to Market: The Alliance for Sustainable Agriculture); Kelly M Young (Field to Market: The Alliance for Sustainable Agriculture)*

Stakeholders in the U.S. commodity crop supply chain need support to make credible public claims about the environmental impact of their farming operations. Field to Market: The Alliance for Sustainable Agriculture is a 501(c)(3) that provides growers, stakeholders, and researchers the Fieldprint® Platform, a sustainability assessment tool for calculating environmental outcomes from individual farm fields. This poster will highlight the eight sustainability metrics currently in the platform, such as estimated soil loss from USDA-NRCS wind and water erosion models. Examples of analysis of soil conservation under different tillage and cover crop managements will be shown. The metrics in the Fieldprint Platform are developed and periodically reviewed and revised through a multi-stakeholder, consensus-driven process. This poster will summarize current metric revision efforts and collaboration opportunities for states and universities as Field to Market undertakes to improve the scientific rigor of the metrics related to greenhouse gas emissions and soil and water quality. Providing quantitative soil carbon and water quality metrics will enable researchers and sustainability project managers to analyze impacts and trends in farming systems and set goals for continuous improvement.

Track: 2024 General Conference Theme

Subject: Conservation Models, Tools, and Technologies

Poster Number 66

ArcGIS StoryMaps as a Tool to Increase Sustainability Awareness on Campus

Authors: *Brooke Bellmar, Sophie Diliberti, Lindsay Frost, and Justin Hougham, University of Wisconsin-Madison, USDA Research and Extension Experiences for Undergraduates*

UW Milwaukee's sustainability efforts are extensive, ranging from green roofs for stormwater management to energy conservation, landscaping, and recycling initiatives. Unfortunately, it is all too easy for students to walk past these projects without ever knowing they exist. Raising awareness of the university's infrastructure– which exists to reach certain sustainability goals–is essential in order to ensure that students feel ownership and investment in these initiatives. To accomplish this goal, we chose to develop an ArcGIS StoryMap because of its engaging interface, which allows students to interact with the complexity of the projects without taking the time to do an in-person tour of each one. We hope that this project will provide a new tool to increase awareness of and personal investment in sustainable infrastructure on campus and document organizational success towards sustainability goals.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Poster Number 67

Correlation of Extension Livestock Water Quality Screenings with Livestock Water Developments and Water Quality in North Dakota Counties

Authors: *Heather Sutherland, Miranda Meehan*

In 2021, North Dakota North Dakota experienced one of the worst droughts on record that impacted the entire state. Drought conditions can increase the concentrations of total dissolved solids (TDS) and sulfates in surface waters. Elevated concentrations of TDS and sulfates can be toxic to livestock. North Dakota State University (NDSU) Extension agents conducted water screenings focused on measuring the concentration of total dissolved solids and sulfates in counties across North Dakota as a part of the Livestock Water Quality Program. The goal of this extension-based screening is to reduce the losses of livestock due to toxic water conditions by identifying poor water quality conditions, and through discussing screening results, encourage water quality testing and make management changes to improve water quality. Water samples were screened for TDS and sulfates using an electric conductivity meter and sulfate test strips, respectively. Samples were classified based on county, sample date and water source. During this same time the North Dakota Department of Water Resources implemented a program to provide cost share for the installation of water developments for livestock producers impacted by drought. The objective of this study is to 1) identify a correlation between NDSU extension agent screenings and subsequent benefits to water quality. The presence and abundance of Extension screening in relationship to developments projects at the county will be evaluated. This will also be correlated to the most recent surface water quality assessment completed in the state. This analysis will allow us to understand the potential broader impacts of this Extension program on livestock and water quality in North Dakota.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Poster Number 68

Crop Farmers Information and Knowledge Sharing Networks: Evidence from Ohio and Michigan

Authors: *Rachel L King (The Nature Conservancy)*; Matthew Houser (The Nature Conservancy)*

Agricultural production is a key contributor to climate change, biodiversity loss, and water quality impairments. The widespread adoption of conservation practices—such as precision fertilizer management and cover crops—can minimize these negative outcomes without limiting agricultural system's capacity to produce food. In the United States' agricultural system, conservation policy is almost exclusively voluntarily based, therefore farmer decision-making is crucial whether practices are implemented. Farmers operate in a complex decision-making environment, where they need to know when to plant, how much seed to buy, when to fertilize, when to harvest, and where to sell. Past research suggests that commodity crop farmers turn to "trusted" sources of information that can help them manage this complexity and shape their decision-making. What is less clear is the nature of the information network farmers are embedded within. Farmers' position within an information network of farmers, agribusinesses, agronomists, dealers, government, and family may be shaped by or shape management practice views and use. What information a farmer learns is dependent on who they talk to, what they read, or where they go for help. Toward better understanding the farmers' information source use, this study explores farmers' connection to trusted sources of agronomic information through a social-network analysis approach. Using semi-structured interviews with commodity crop producers in Ohio and Michigan, we examine farmers' interconnectedness within a multi-stakeholder network of influential information sharing. We advance our understanding of the nature of knowledge exchange within agricultural communities and its behavioral implications. Practically, by identifying the "key" players in this farmer network, this work can help facilitate connections within a local farmer community, and potentially enable the more effective seeding of behavioral change through information exchange efforts.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Cultivating Continued Conservation Through Networking

Authors: *Olivia C Caillouet (University of Missouri)**

Networking includes aligning the interests of individuals, groups, and communities to create beneficial interactions and advance initiatives. Importantly, hosting a networking event differs from being an attendee. Hosts are responsible for facilitating conversations and fostering meaningful connections. This poster will present various networking methods for hosts. In addition to examples of networking pathways, some qualitative data from a climate-smart commodities project training with a networking component will be shared. For example, planning a networking event includes outlining an overall purpose, time available, number of attendees and familiarity of group members, budget, and space availability. More specifically, hosting a networking event has been refined to several main steps that include selecting a format and agenda for the target audience, confirming a date and time, event promotion, preparing for guests, hosting the event, and post-event evaluation. Examples of networking could be:

• Speed networking where attendees share one-on-one with the help of thoughtfully designed icebreakers (trending or farm-specific topics) that start conversations

• Collaborative group challenges that promote teamwork and discussions. This could take different forms from roundtables to viewing or modifying farm equipment used with conservation practices

• Workshops with an emphasis on interactive learning that encourages problem-solving

• Well-being activities like meeting at a park or reflective conversations around a farm campfire

• Volunteering for an organization with a common value and fostering purpose and fulfillment

• Farm tours that enhance a sense of community with designated time for conversing

The conservation sector requires multi-skilled, interdisciplinary experts who are supported. One way to further professionalize conservation requires strengthening networks through thoughtful planning and coordination.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Poster Number 70

From Streams to Solutions: A Summer in Water Quality Extension

Authors: *Emily Bruce, REEU Watershed Management Intern; Catherine DeLong, Iowa State University Extension and Outreach*

To implement conservation practices, there needs to be direct engagement between farmers and conservation professionals. In recent years, research has found that “interaction with a conservation professional over time is a consistent predictor of farmer adoption of conservation practices” (Morris et. al, 2021). Implementing conservation practices in agriculture is crucial to assure water and soil resources for future use, protect crop productivity, and maintain the ecological balance of the region's waterways. Currently, in Iowa where this project is based, it is difficult to find information online about conservation initiatives and professionals around the state. Our project seeks to help farmers and landowners easily find and connect with local conservation professionals. Find My Watershed Coordinator, is an online map that showcases watershed projects, and the conservation professionals who manage those projects, in the state of Iowa. Watershed coordinators are a subset of conservation professionals who offer technical and financial assistance to farmers and landowners in a defined watershed. This project is a collaboration with the Sand County Foundation, Geographic Information System experts at Iowa State University, and watershed coordinators. The purpose of the digital map is to serve as a resource for farmers to locate their local conservation professionals. By visiting the site, individuals can hover over watersheds to see local projects and locate relevant resources, such as contact information or links to project websites. This tool increases the accessibility of information for those looking to adopt conservation practices onto their land. Conservation practices are more likely to be successfully implemented if there is direct communication between farmers and a professional.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

New Mexico Restoration and Soil Health Initiatives

Authors: *Matt Wiseman (NRCS)**

Range and forest lands constitute a significant portion of New Mexico's 78-million-acre land base, including federal, state, tribal, and private lands, as well as historical land grants. There are approximately 6,800 ranches and 2,800 federal allotments, or grazing permits in the state. With federal and state land management agencies controlling approximately 42% of the land in NM, the Regional Conservation Partnership Program (RCPP) allows us to work across multiple land ownerships.

RCPP projects in New Mexico primarily address the encroachment of invasive woody species on New Mexico range and forest lands by utilizing shrub/tree thinning and removal practices to improve overall range and forest health and wildlife habitat.

The poster highlights Partner/Community Engagement, Project types with practices, Conservation benefits, and Outcomes.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Saving Tomorrow's Agriculture Resources (STAR): Illuminating the Path to Farmer-Led Conservation

Authors: *Amanda Raster (STAR)*; Caroline Wade (STAR)*

STAR is a simple, standardized, science-based framework that facilitates conservation practice adoption across a variety of agricultural production systems, in collaboration with state-level Affiliate partners. This poster will outline the methods used to develop the STAR rating system for evaluating field-level conservation implementation in partnering states, including an assessment of local natural resource concerns and conservation practices that address them, development of state-specific field evaluation forms and scoring methodologies informed by scientific evidence and practical application, and development of outcomes estimation methodologies to quantify the benefit of conservation practice implementation. The poster will describe the resources and recognition provided to participating STAR producers, including field-level STAR scores; customized conservation improvement plans; connections to locally-tailored technical support and resources; and connections to supply chain partners offering financial incentives for conservation. Program summaries and outcomes across states currently participating in STAR (Illinois and Colorado) will be provided, along with a description of an expansion underway to bring STAR to several states in the West and Midwest (Washington, Utah, New Mexico, Wyoming, Idaho, Montana, Missouri, and Iowa) over the next three years, and lessons learned to date. This poster will be particularly relevant to conservation professionals interested in learning about a novel, grassroots approach to encourage and support conservation practice adoption on agricultural lands.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Watershed Outreach and Management: StoryMaps as a Tool for Virtual Place-Based Education

Authors: *Sophie Diliberti, Brooke Bellmar, Nuzhat Nawshin, David Hart, Rob Roth, and Justin Hougham, University of Wisconsin-Madison, USDA Research and Extension Experiences for Undergraduates*

Outdoor education is driven in large part by place-based pedagogies which aim to use personal attachment to place to connect students' academic studies with their real-world experiences. This is essential to providing students with a comprehensive and contextualized understanding of current issues of climate and sustainability. Our project explores the ability of ArcGIS StoryMaps to help students develop this sense of place while learning about Green Infrastructure. We create story maps that function in multiple contexts: situations where the student is unable to be in the physical location the map represents as well as situations where the map functions as a supplement to in-personal exploratory learning in that setting. In doing so, we aim to provide an additional tool for outdoor educators by demonstrating the effective use of ArcGIS StoryMap technology in place-based learning.

Track: 2024 General Conference Theme

Subject: Cultivating Conservation Technical Assistance, Community, and Networks

Tracking the Flow of Nutrients in Forest Ecosystems Using Plant Root Simulator (PRS) Probes

Authors: *Kenneth Greer (Western Ag Innovations Inc)**

A healthy terrestrial ecosystem is often characterized by the tight cycling of nutrients, diverse species and a natural resilience to expected perturbations. In the forest, species diversity is often managed for the purpose of wood production or habitat creation. In order to manage the ecosystem for a desired outcome, timber managers often shift the species mix using planting, harvesting and thinning techniques. Nutrient management methods have been less commonly used only because the assessment tools for soil nutrients, transferred from Ag research, are not adequate to monitor the tight cycling of bioavailable nutrients in the forest. The Plant Root Simulator (PRS) ion resin probe is a proven effective tool to monitor and predict the soil nutrient bioavailability. Our poster highlights the utility of PRS probes in forest ecosystems management from Loblolly pine to Douglas fir.

Track: 2024 General Conference Theme

Subject: Healthy Forest Ecosystems: Research, Policy, and Applied Science of Ecological Conservation and Restoration Across Landscapes and Watersheds

Accelerating the Implementation of Agricultural and Forestry BMPs through the Regional Conservation Partnership Program

Authors: *Marli Rupe, VT Agency of Natural Resources, Department of Environmental Conservation*

The VT Department of Environmental Conservation has received two RCPP grants that are focused on improving water quality. This poster summarizes some of the unique highlights of this program as well as the successful outcomes with agricultural and forestry landowners.

Track: 2024 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Equipping Tomorrow's Conservation Workforce: Our Year in the SWCS Emerging Leaders Program

Authors: *Soil and Water Conservation Society Emerging Leaders*

Explore the SWCS Emerging Leaders Program through this comprehensive poster presentation. Gain insights into the program's structure, modules, and collaborative projects aimed at cultivating the next generation of conservation leaders. Delve into the tangible outcomes and impacts of the program, showcasing its effectiveness in fostering leadership skills and driving innovative conservation initiatives. Don't miss this opportunity to learn about the transformative journey of emerging leaders shaping the future of conservation.

Track: 2024 General Conference Theme

Subject: Outreach, Education, and Community Engagement

The Right Message, The Right Messenger: The Importance of Farmer Networks in Increasing Conservation Adoption

Authors: *Kennedy Mayfield-Smith (National Wildlife Federation)*; Jenny Berkowitz (National Wildlife Federation)*

Conservation messages are known to have the most impact when delivered by trusted messengers, namely other farmers and local partners with existing, authentic relationships with their target audience. In 2013, the National Wildlife Federation created the Conservation Champions Program to increase awareness of soil health practices while strengthening outreach capacity through ongoing support for innovative outreach delivered by peer farmer messengers. With guidance from NWF staff, champion teams learn and practice novel outreach strategies and skill building through in-person training to understand how to reach new audiences and influence behavior change. Farmers, ranchers, and outreach staff from diverse geographies and backgrounds across the Mississippi River Basin are embedded in an ever-expanding network of Champions that facilitates unique farmer partnerships, strengthened peer-to-peer learning, and lasting local change in relation to the use of sustainable farming practices.

Track: 2023 General Conference Theme

Subject: Outreach, Education, and Community Engagement

Analyzing Perspectives on the Motivations and the Knowledge Gaps Impacting CRP Participation in the Midwest and Southern USA

Authors: *Daniel Egerson (Mississippi State University)*; Bradly Thornton (Mississippi State University); Shannon Westlake (United States Fish and Wildlife Service); Mark McConnell (Mississippi State University); Sathishkumar Samiappan (Geosystems Research Institute - Mississippi State University); Amanda Sesser (U.S. Fish and Wildlife Service); Diego Thompson (Mississippi State University); Kristine O. Evans (Mississippi State University)*

The motivations to participate in the Conservation Reserve Program (CRP) may vary, but the intention to adopt specific practices is intricately tied to the information accessible to them and their interactions with practitioners. However, the efficacy of these interactions is contingent upon how well landowners are able to communicate their intention, which in turn, influences the nature of information provided by practitioners ultimately impacting their enrollment decisions. This research examined the current motivations for participating in CRP from the perspectives of agricultural landowners and practitioners while assessing the knowledge gaps shaping conservation outcomes in the program. Data was elicited from 37 landowners and 107 USDA staff and technical service providers in selected counties across Mississippi, Missouri, and Illinois using survey design and focus group discussions. The preliminary findings revealed that motivations include financial compensation, peer influence, soil conservation, improvement in water quality, and wildlife populations. The majority of surveyed landowners communicated difficultly differentiating CRP practices and a general lack of knowledge of key terms, such as signup periods. Similarly, just over half of sampled practitioners felt they had a working knowledge of the eligibility criteria for the program. Some landowners felt they were unable to enroll in a practice of interest because they were unaware it existed, and some practitioners confirmed that landowners might be discouraged from enrolling in certain practices because the maintenance and management requirements were perceived too challenging for the landowners to implement or potentially too difficult for practitioners to enforce. Overall, our results provide valuable insights on how engagement among landowners and practitioners, along with improved clarity on CRP practice availability and requirements can positively affect landowner decision-making and sustain their interest in conservation programs.

Track: 2024 General Conference Theme

Subject: Social Sciences Informing Conservation

Comparative Effects of Diverse Cover Crops on Corn Yield and Soil Health in Midwestern Agroecosystems

Authors: *Emily J Diaz Vallejo (Dairy Forage Research Center USDA-ARS)*; Alison Duff (Dairy Forage Research Center USDA-ARS); Jose G Franco (USDA ARS Dairy Forage Research Center)*

The adoption of conservation practices in Midwestern agroecosystems faces challenges due to the occasional negative impacts of cereal rye cover crops on subsequent corn yields. Despite cereal rye's effectiveness in increasing soil organic matter and reducing nutrient loss by runoff, its potential for soil nitrogen immobilization raises concerns about nitrogen availability for corn. In this study, we aim to investigate whether diverse non-cereal cover crops can mitigate the negative effects of cereal rye on corn yield while maintaining soil health benefits. We conducted a randomized complete block experiment in corn-to-corn rotations across two Wisconsin farms, comparing eight cover crop treatments, including winter cereal rye, winter triticale, hairy vetch, winter camelina, and their combinations, against a control with no cover crops. Soil samples were collected pre-cover crop planting and post-termination to analyze pH, phosphorus, potassium, organic matter, total nitrogen, nitrate, ammonium, and total carbon at a 60 cm depth. Initial findings indicate variable nutrient uptake with higher phosphorus levels overall post-harvest, lower organic matter, and no change in soil potassium. These findings suggest that cover crop diversity may not significantly affect soil nutrient levels within one growing season, highlighting the complexity of nutrient dynamics in cover-cropped systems. Further analyses will examine the interaction between treatments and time across different growing seasons, including ammonia and nitrate data. Our research contributes to the development of novel management practices that leverage cover crop diversity to sustain soil health without compromising corn yield.

Track: 2024 General Conference Theme

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

Cover Crop and Tillage Interactions for Better Soil Health in North Carolina in the Coastal Plain, North Carolina

Authors: *Carlee Epting (North Carolina State University)*; Luke Gatiboni (North Carolina State University); Alex Woodley (North Carolina State University); Ron Heiniger (North Carolina State University); Ekrem Ozlu (North Carolina State University); Rod Gurganus (North Carolina State University)*

The sandy soils of the North Carolina Coastal Plain present unique challenges to sustainable agriculture, characterized by low organic matter level and weak soil structure. This study investigates the intricate interplay between cover crops and tillage practices to enhance soil health in this region. The research compares the long-term effects of different tillage practices, alongside unmanaged control sites like pasture and forest. Addressing and analyzing these conditions among varying tillage managements, can help provide farmers with knowledge of how to best utilize their fields. Two sets of soil samples, intact core, and composite were taken from each field within 3 replications. Total analytics taken include bulk density, pH, EC, texture, moisture content, and soil water holding capacity. The results of this study aim to provide farmers with knowledge of their fields in a physical, chemical, and biological capacity, as well as create comparisons between different field management systems. From initial analysis, subsurface compaction layer likely impacts how elements and water move throughout the soil profile in sandy coastal plain soils. Elemental distribution is higher in soils where tillage was recent. Magnesium was the lowest element in both depths. Understanding the varying impacts differing management systems can have on soil health indicators, can provide a basis for other studies and new research exploring these management systems.

Track: 2024 General Conference Theme

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

Defining Soybean Yield Reduction on Soils with Increasing Saltwater Intrusion Issues in the Coastal Plain, North Carolina

Authors: *Anselme Dossou (North Carolina State University); Luke Gatiboni (North Carolina State University); Rob Austin (NC State University); Matthew Ricker (North Carolina State University); Ekrem Ozlu (North Carolina State University)*; Wesley Childres (North Carolina State University); Alton Wood (North Carolina State University); Rod Gurganus (North Carolina State University); Andrea Gibbs (North Carolina State University)*

Saltwater intrusion, the invasion of soils by salt water from oceans and sounds, is increasing throughout coastal agricultural lands leading to soil salinization. In the tidewater region of North Carolina, this process is facilitated by many factors like sea level rise, which is projected by the National Oceanic and Atmospheric Administration (NOAA) to be around 0.6 meters (2 feet) by 2100. Farmers in this important soybean production region are changing cropping systems and even abandoning fields due to the increasing salt concentrations in the affected soils. Geographic Information System (GIS) tools were used to identify the soil map units most at risk with 2 feet sea level rise by 2100. To investigate soybean tolerance to salinization, we tested in a greenhouse experiment the tolerance of two soybean varieties (chlorine includer, and chloride excluder) to five soil salt concentrations in two representative soils (mineral and organic) of the Tidewater region. Additionally, an on-farm field study was conducted to determine the toxic limits of Soluble Salt Index (SS-I). The soluble Salts Index was analyzed in 135 soil samples collected from nine soybean fields in Hyde and Pasquotank counties. Soybean yield was measured at the same spots where soil was analyzed. Soybean yield was significantly ($p \leq 0.05$) affected by increasing SS-I. The results showed that SS-I ≤ 77 is safer for growing soybean and have few impact on yield reduction, whereas SS-I ≥ 203 causes a complete loss of soybean productivity with over 90% reduction of yield.

Track: 2024 General Conference Theme

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

Influence of Fertility and Tillage on Soil Carbon Indicators after 50 Years

Authors: *Gabriella Burkett (Southern Illinois University)*; Omid Zandvakili (Southern Illinois University); Amanda Weidhuner (Southern Illinois University); Amir Sadeghpour (Southern Illinois University); Andrew J Margenot (University of Illinois Urbana-Champaign); Ronald Krausz (Southern Illinois University); Dane Hunter (Southern Illinois University)*

Switching from conventional tillage operations to no-till often improves soil properties but the magnitude of change in soil carbon and carbon indicators need to be evaluated. The primary objective of the present study was to evaluate the effect of 50 years of contrasting tillage practices and fertilizer on soil organic carbon (SOC), permanganate oxidizable C (POXC), water extractable organic C (WEOC), potentially mineralizable C (PMC 24 hr and PMC 96 hr), β glucosidase activity (BG), along with phospholipid fatty acid (PLFA) composition. The experiment had a split plot layout in randomized complete block design with four replicates. Tillage treatments were (1) moldboard plow to 15-20 cm depth (MP), (2) chisel disk (15 cm depth) (CD), and (3) no-till (NT). The two fertility treatments were (1) conventional NPK rates and (2) a no-fertilizer control. Our results indicated that only NT when fertilized with NPK can increase soil organic matter. This indicates C inputs by higher yields in MP and CD will not translate into higher C due to disturbance. Fertilization increased SOC compared to the no-fertilizer control mainly due to higher SOC in NT. PMC-96 decreased in order of NT>CD>MP in fertilized plots reflecting disturbance effect. Water extractable WEOC was higher in NT at the fertilized plots than other tillage practices. Similar WEOC in tilled fertilized plots with NT without fertilizer indicated lack of disturbance drives higher WEOC in fertilized NT treatment. No-till had higher POXC at the fertilized plots than other tillage practices. The PLFA biomass was similar among treatments. Our results suggest that no-till only improves soil C when soil fertility requirements are met and under low fertility conditions, tillage can result in greater crop yields and C inputs than NT, and thus, compensate for the disturbance.

Track: 2024 General Conference Theme

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

Measurement of Biological Nitrification Inhibition (BNI) Activity in Maize Varietals via Nitrosomonas europaea

Authors: *Lauren Stanton (Kansas State University)*; Jeongdae Im (Kansas State University); Seongmin Yang (Kansas State University)*

The nitrogen-use efficiency (NUE) of agricultural plants is notoriously poor. Ideally, nitrogen fertilizers, mostly in the form of ammonia, would remain in its original form to allow plants to utilize this essential nutrient. However, ammonia is easily converted into other forms within the soil by a microbial process called nitrification. Nitrification is the two-step aerobic process that converts ammonia into nitrate. The primary step of nitrification employs Nitrosomonas bacterium to convert ammonia into nitrite (NO2-). Throughout this process, nitrous oxide (N2O) is released as a by-product. Nitrous oxide is one of the top three most potent greenhouse gases and is the primary ozone-depleting substance. Thus, it is important to understand and suppress nitrification within agriculture. Recent studies have established that plants can release compounds, known as Biological Nitrification Inhibitors (BNIs), through their roots to impede nitrification. These BNIs hinder the proper functioning of enzymes required for nitrification. To assess the BNI potential of maize, we conducted a comparative analysis of inhibition levels exhibited by different maize varieties at weekly intervals during each growth stage. Maize root exudates were introduced to liquid media containing bioluminescent Nitrosomonas europaea. We optimized the BNI assay protocol and identified several maize varieties with highest BNI potential. These varieties will be used as a model to explore the genetic basis of maize BNI and transfer the BNI activity to elite maize varieties. Understanding the BNI activity of maize is the first step to improving the efficiency of nitrogen fertilizer and creating a more sustainable future for the agricultural industry.

Track: 2024 General Conference Theme

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

Phosphorus Dynamics in a Palustrine Wetland Chronosequence in the Northern Mississippi Embayment

Authors: *Cora L Aossey (University of Kentucky)*; Glynn Beck (Kentucky Geological Survey); Jason Unrine (University of Kentucky); Tanja Williamson (United States Geological Survey); Leighia Eggett (University of Kentucky); Brad Lee (University of Kentucky)*

The Natural Resources Conservation Service Wetland Reserve Easements aspect of the Agricultural Conservation Easement Program is focused on converting marginal agricultural lands to wetlands to restore hydrologic function and enhance wetland habitat. Currently, there is a gap in knowledge of how phosphorus (P) dynamics develop as these wetlands are converted from row crops to wetland vegetation over time. Wetlands may be anticipated to retain sediment and particulate P, however the saturated environment could result in a release of dissolved P. In this study, we will use a chronosequence of former farmlands now being converted to forested palustrine wetlands in the northern Mississippi Embayment to evaluate the form and mobility of P over time post-conversion. Phosphorus content in the nonlabile and labile P pools at the soil surface (0-10 cm) have been evaluated on a 10-m grid within a paired chronosequence of wetlands at three distinct ages (0, 7, and 33 years), thus exemplifying wetland conversion from row-crop fields. It is hypothesized that the 7- and 33-year-old wetlands will contain the highest amount of labile P in the soil, while the new wetlands will have a lower amount of labile P. The results will be discussed and are expected to further our knowledge of nutrient retention when row-crop lands are converted to palustrine wetlands.

Track: 2024 General Conference Theme

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

Predicting Soil Protein Using Dynamic Soil Properties for Soil Health Data

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

The dynamic soil properties for soil health (DSP4SH) database consists of rigorously collected data of dynamic soil properties on soil health metrics that were deemed to be ecologically important. Among the potential metrics for soil health assessment, the measurement of the labile organic nitrogen (N) pool emerges as particularly promising candidate. This specific N pool has demonstrated sensitivity to changes in management and variability in seasonal nitrogen availability. The supply rate of amino acids, a process also referred to as depolymerization, is a critical factor influencing the rate of soil nitrogen cycling. It further serves as a bioavailable N reservoir ready for mineralization. In this Dynamic Soil Properties for Soil Health (DSP4SH) project, the quantification of this bioavailable N was conducted by the Soil and Plant Science Division of NRCS and university cooperators using the autoclaved-citrate extractable (ACE) soil proteins method, which was implemented across eight different states. The results derived from various soil series were classified according to the associated management system or ecological state. However, the direct measurement has been deemed laborious for production laboratories, therefore the need for predicting soil protein based on associated soil properties would alleviate this challenge. The overarching goal is to explore ACE patterns using generative additive mixed models and then develop enhanced pedotransfer functions (PTF) that would predict ACE based on best modeling structure. This will enhance our understanding of predictive value of soil protein and its relationship with pedodiversity and soil management practices.

Track: 2024 General Conference Theme

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

Prioritizing Soil Health Metrics for Predicting Edge-of-Field Water Quality Outcomes in the Great Lakes Basin

Authors: *Molly Meyers (UW-Green Bay)**

In the pursuit of implementing effective conservation practices to enhance soil health and water quality, farms and conservation professionals face the challenge of developing a measurement strategy that accurately assesses progress toward conservation goals. The extensive variety of methods available for measuring soil health can make this task daunting and resource-intensive, complicating comprehensive application. Our presentation aims to simplify this complexity by highlighting soil health metrics that are not only indicative of edge-of-field (EOF) water quality losses in the Great Lakes Basin but are also practical and feasible for long-term monitoring. To ground our metric prioritization in empirical evidence, we analyze soil and water data from 14 EOF sites across Wisconsin, Michigan, Indiana, Ohio, and New York. This analysis is complemented by insights from relevant scientific literature, offering a holistic view of how soil health metrics correlate with EOF water quality outcomes and guiding the selection of the most impactful and manageable metrics for conservation efforts.

We utilized a systematic approach to rank soil health metrics, focusing on four criteria to ensure both scientific rigor and practical applicability. Firstly, we assess the correlation of soil health metrics with EOF losses, examining both theoretical relationships and observed data to prioritize metrics with predictive capabilities for water quality outcomes. Practicality also plays a central role in our evaluation process, where we assess the ease of measurement by considering various factors such as time, cost, and equipment needs. Moreover, the responsiveness of soil health metrics to changes in field practices within a five-year timeframe is examined to identify those that offer timely feedback for conservation management decisions. Lastly, resilience to seasonal changes is a key consideration; we assess the stability of each metric under diverse environmental conditions, including fluctuations in temperature and moisture. This prioritizes metrics that remain comparable across varying climatic conditions.

Our initial results prioritize soil chemical metrics (e.g., soil organic carbon, total nitrogen and soil test phosphorus) due to their ease of measurement and strong correlation with EOF losses. Conversely, some soil biological metrics tend to rank lower, primarily due to their lower resilience to varying climatic conditions, which challenges their comparability across fields and seasons.

Our findings will provide actionable insights for farmers and conservation professionals in the Great Lakes Basin. By identifying soil health metrics that balance predictive accuracy with practical feasibility, our research supports more efficient and targeted measurement strategies in this region.

Track: 2024 General Conference Theme

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

Simultaneous Determination of β-glucosidase, β-glucosaminidase, Acid Phosphatase, and Arylsulfatase in Double Cropping Wheat Agroecosystems Across Texas

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

Extracellular enzyme activities in soil are used to measure the nutrient cycling potential of a system and are often used as an indicator of soil health. Performing individual enzyme assays can be costly, time consuming, and labor intensive. The use of a combined assay to simultaneously determine enzyme activity can be used to cut down on time, cost, and labor while giving an overall biogeochemical cycling index associated with the nutrient cycling potential of the system. This study aimed to evaluate the relationship between the sum of individual enzyme assays compared to the simultaneous measurement, as well as evaluate the associated trends in double cropping systems across three sites in Texas: Texas A&M AgriLife Research- Beeville Station; Texas A&M AgriLife Research Center in Lubbock; and the Stiles Farm Foundation in Thrall. Tillage treatments included: 1) conventional tillage (disk plow), 2) strip-till, or 3) no-till. Cropping treatments included: 1) wheat-sorghum, 2) wheat-sesame, 3) wheat-cowpea, 4) wheat-cover crop mix, or 5) wheat-summer fallow. A positive and significant linear relationship was present between the summed and simultaneously determined enzyme activities at Beeville (R2 = 0.65), Lubbock (R2 = 0.85), and Thrall (R2 = 0.96). Significant differences associated with trends from the use of the combined enzyme assay differed between locations, cropping system, tillage management, and soil depth. Overall, systems that implemented a secondary crop measured greater enzyme activity at 0-5 and 5-15 cm when compared back to the fallow system. Conservation tillage management practices (no-till and strip-till) measured greater enzyme activity when compared to conventional tillage at 0-5 cm, but the opposite was measured at 5-15 cm with greater enzyme activity measured in conventionally tilled systems. This evaluation illustrates the need for further research to contribute to the development of a biogeochemical cycling index associated with the simultaneous determination of β-glucosidase, N-acetyl-β-glucosaminidase, acid phosphatase, and arylsulfatase across soil differing in inherent characteristics, management practices, and climate.

Track: 2024 General Conference Theme

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

Soil Health Impact of Different Methods of Establishment of Organic Native Warm Season Grasses

Authors: *Binsiya Kallingal (University of Tennessee, Knoxville)*; Sindhu Jagadamma (University of Tennessee)*

To support the fastest growing organic livestock sector in the US, there is a critical need to produce high quality organic forages. In the southeastern US, pasture systems are dominated by cool season tall Fescue (Festuca arundinacea) grass. The yield and quality of tall Fescue decline as temperature increases in summer. A potential solution to this yield decline is the introduction of Native Warm Season Grasses (NWSGs) which are adapted to the unique climatic conditions and soil characteristics of the southeastern US. However, establishing organic NWSGs requires well prepared, weed free seed bed. In this study, we focus on testing the short-term soil health impacts from three NWSG establishment methods: i) intensive tillage, ii) growing pearl millet and cereal rye as smother crops under reduced tillage with subsequent biomass removal, and iii) growing the smother crops under reduced tillage with subsequent residue retention. We collected soil samples from 0-10 cm and 10-30 cm depths and analyzed for a suite of soil health metrics. The tilled plots exhibited higher available P, K, Ca and Zn (10.06, 110, 917 and 3.01 mg/kg; respectively) compared to the smother crop plots (7.18, 89.27, 878 and 2.73 mg/kg; respectively) at 0-10 cm depth. Although these results did not show statistical differences across treatments, this can be attributed to the short-term nature of the study. Analysis of additional soil metrics is currently ongoing and will be presented at the conference. This study will enhance the understanding of how land management impacts soil ecosystems, offer valuable insights for organic farmers seeking sustainable alternatives to conventional tillage practices. Exploring integrated management approaches, knowledge transfer and collaboration with stakeholders are the next steps to advance sustainable NWSG establishment.

Track: 2024 General Conference Theme

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

The Effects of Manure Applications on Crop Growth and Soil Greenhouse Gas Emissions in The Texas High Plains

Authors: *Tessa Roberts (Texas A&M Agrilife Reseach)*; Katie Lewis (Texas A&M Agrilife)*

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 carbon mitigation/sequestration 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. The treatments utilized in this study included: 1) no fertilizer applied, 2) inorganic fertilizer, 3) composted manure, 4) separated dairy feedlot manure, 5) whole digestate, and 6) commercial raw feedlot manure. Results included the 2023 growing season. Greenhouse gases (CO2, CH4, N2O, NH3) were measured from the soil surface throughout the season using a multi-gas FTIR analyzer. Results included cotton lint yield and greenhouse gas emissions for CO2, CH4, N2O, and NH3 that were presented as CO2 equivalents.

Track: 2024 General Conference Theme

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

To Improve Soil Health, Sorghum Is Cultivated Alongside Alfalfa or Sainfoin in an Intercropping System

Authors: *Franklin C Omeye (North Dakota State University)**

Alfalfa (Medicago sativa) and sainfion (Onobrychis Viciifolia) play a crucial role in water and soil conservation due to their deep-rooted nature and ability to improve soil structure., but they have low forage productivity in the establishing year. This discourages farmers from growing alfalfa because it takes up space on farms that could be used for other cash crops and is not cost-effective, specifically in the seeding year. Intercropping systems come with numerous benefits to soil health, and results from previous research have shown that new alfalfa stands can be successfully established while growing corn (Zea mays L.) in intercropping without significant differences in forage yield and nutritive value while improving soil health. This research was conducted to evaluate the implications of integrating alfalfa or sainfoin in an intercropping system with forage sorghum (Sorghum bicolor L.) (FS), with the aim of increasing the alfalfa acreage and increasing forage productivity, especially in the seeding year in ways that are most economical and sustainable. This experiment was conducted in Fargo and Prosper, ND, USA, in 2023–2024. The design of the experiment was a randomized complete block with four replicates. The treatments for this study included (1) alfalfa alone, (2) alfalfa-FS at 40 kg N/ha (40N), (3) alfalfa-FS at 80 kg N/ha (80N), (4) sainfoin alone, (5) sainfoin-FS at 40N, (6) sainfoin-FS at 80N, and (7) FS alone. Forage sorghum yield was not significantly affected when intercropped or with different N rates. When alfalfa was compared with sainfoin, alfalfa yield was greater, either planted alone or with FS. Alfalfa at different N rates was not significantly different from alfalfa alone. In Fargo, FS only had one cut in the season, and the forage nutritive value was the same across all treatments. In the first cut from Prosper, FS total digestible nutrients (TDN) were highest when intercropped with alfalfa and sainfoin at 80 kg N/ha. Overall, a high presence of beneficial insects in the plots intercropped with alfalfa was observed, which is evidence of healthy soil. Optimizing this cutting-edge cropping method could increase crop productivity and benefit farmers, protect the soil from erosion, reduce nitrogen fertilizer applications to the cash crop, and reduce nitrogen losses to air and water.

Track: 2024 General Conference Theme

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

Transition to Sufficiency Phosphorus Management and the Effect of Cover Crop Presence on Dynamic Soil Health Indicators in a No-Till Corn and Soybean Rotation

Authors: *Amber Pasket (Kansas State University)*; Laura M Starr (USDA-NRCS); Catherine Stewart (Kansas State University); Nathan Nelson (Kansas State University); Ganga Hettiarachchi (Kansas State University); Gerard Kluitenberg (Kansas State University); Kraig Roozeboom (Kansas State University); DeAnn Presley (Kansas State University); Peter Tomlinson (Kansas State University)*

Soil testing laboratories base phosphorus (P) recommendations on two approaches: build and maintain (BAM) and sufficiency (SUF). A study was initiated in 2014 in Manhattan KS to determine the effects of P fertilizer source and timing as well as the effects of cover crop presence on soil health in a no-till corn- soybean rotation. The experimental design was a 2x3 full factorial in a randomized complete block design. The cover crop treatment consisted of the presence or absence of a cover crop. The three P fertilizer management treatments included fall surface broadcast diammonium phosphate (FB), spring subsurface injected ammonium polyphosphate (SI), or no P fertilizer (NP). Phosphorus fertilizer rates were based on BAM recommendations from 2014-2019. In 2020, the FB treatment transitioned into SUF-based management. No P was applied to the SUF treatment since December 2018. The effects of P fertilizer, cover crop presence, and their interaction were evaluated for soil enzyme activities (β-glucosidase, β-glucosaminidase, and acid and alkaline phosphatase), active carbon (C), soil respiration, and microbial biomass C. Soil samples were collected following corn/soybean harvest in the fall at 0-5 cm from 2018 through 2022. Years were analyzed separately due to crop rotation. Preliminary results have shown that the presence of a cover crop influenced a majority of soil health indicators during the five years. The variability in soil health indicators in response to cover crop presence is likely due to climatic differences that effected microbial activity and cover crop growth/decomposition. There were very few interactive effects or main effects of P fertilizer treatment throughout the five years. The lack of response to SUF-based P management suggests that cover crop presence was the primary driver of soil health indicators during the transition period.

Track: 2024 General Conference Theme

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

Appraisal of AquaCrop model for barley crop production under semi-arid conditions of Haryana, India

Authors: *Navreet Bassi (CCS Haryana Agriculture University)**

Barley is one of the most important cereals of the world. It is cultivated in almost all parts of the world except the tropical regions. Barley is a major source of food for larger number of people living in the cooler semi-arid regions of the world where wheat and other cereals are less adapted. The present study is important for the local farmers who are interested in production of barley crop and for the agronomists and agricultural meteorologists who adapt the crop production with respect to climate of the region and try to predict their outcome. The present study was conducted in Research farm of Department of Agricultural Meteorology, CCS HAU, Hisar for two seasons 2019-20 and 2020-21. Barley crop was sown in four different dates: 15th November 2019 and 28th November 2020 (D1), 30th November 2019 and 14th December 2020 (D2), 15th December 2019 and 28th December 2020 (D3) and 30th December 2019 and 8th January 2021 (D4). The objectives of the experiment were: to evaluate AquaCrop model for barley crop for semi arid conditions in Haryana and to estimate barley crop water productivity (CWP) in different growing environments. During the experiment, observations were recorded for plant growth parameters, soil moisture content at various depths (15, 30, 60 and 90 cm), soil temperature, micro-meteorological parameters and yield and yield attributes. The AquaCrop was evaluated using the observed parameters recorded during the two-season experiment. From the experiment it was concluded that the model showed a closer estimate with the crop sown in November (D1) than in crop sown in second fortnight of December or later (D3 and D4). After the evaluation of the model it was concluded that AquaCrop can effectively work for the semi-arid conditions of Haryana for November sown crop (D1). Timely sown crop (D1) observed to have higher duration and hence by applying the working principle of AquaCrop model, there was more transpiration predicted by the model resulting in more dry biomass estimated and higher grain yield and hence model performed better under timely sown conditions (D1) than late sown conditions. Climatic conditions were added as input to the model. Atmospheric temperature of the timely sown crop is higher and optimum for the barley crop than late sown crops with lower atmospheric temperature which reduced germination percentage of the crop. The CWP was observed to be higher in season 2020-21 than season 2019-20. Crop season 2019-20 observed lower temperature and higher rainfall than 2020-21 crop season. November sown crop showed a higher CWP than December and January sown crop. November sown crop showed a higher yield and plant growth parameters than December and January sown crop. The model can be used as a tool to understand crop response to environment change, effect of global warming on agricultural production and simulates yields with respect to water resource availability and application.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management

Evapotranspiration of Rain-fed Mixed Perennial Grass Production Systems in Western Nebraska

Authors: *Colleen Zumpf (Argonne National Laboratory)*; Jules Cacho (Argonne National Laboratory); John Quinn (Argonne National Lab); Marty Schmer (USDA-ARS); Daren Redfearn (University of Nebraska Lincoln); Julie Peterson (University of Nebraska Lincoln); Cristina Negri (Argonne National Laboratory)*

Agricultural production systems in the U.S. Northern Great Plains rely heavily upon irrigation water to support high crop productivity. Declines in available groundwater resources from the Ogallala aquifer raise concerns for the long-term sustainability of water resources, especially as the prevalence of droughts has increased. This study evaluates the production of rain-fed perennial bioenergy grasses on a portion of these irrigated croplands as an alternative crop to minimize water demands while providing harvestable biomass for bioenergy or bioproducts. Evapotranspiration (ET) of six large-scale, long-term, paired agricultural fields were monitored from 2021-2023. Each pair included an irrigated corn or soybean field and a neighboring Conservation Reserve Program (CRP) mixed perennial grass field (used as a proxy for a native bioenergy grass such as switchgrass or a low-diversity grass mixture). Evapotranspiration was measured using a remote-sensing, energy balance-based model called the Mapping EvapoTranspiration at high Resolution with Internalized Calibration (METRIC) model. The METRIC model uses Landsat satellite imagery (Landsat 7, 8, and 9) and ground-based weather stations to estimate daily ET at a 30-m spatial resolution. Results highlight the difference in evapotranspiration between the paired fields, with lower ET observed during the summer months in the CRP sites compared to irrigated corn and soybean fields. These results provide valuable data to support other water use metrics modeled as a part of this study and evaluate the sustainability of producing perennial grass bioenergy crops as an alternative to irrigated row crops in the U.S. Northern Great Plains.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management

Flood Detection by Using Polarimetric Synthetic Aperture Radar (PolSAR) Decompositions and the Deep Residual U-Net Approach to Enhance Food Security

Authors: *Sayed Bateni (University of Hawai'i at Mānoa)*; Jinwook Lee (University of Hawaii at Manoa); Saeid Janizadeh (University of Hawaii at Manoa); Alexander Melancon (University of Alabama Huntsville); Andrew Molthan (NASA Marshall Space Flight Center)*

Extreme flood events negatively impact the well-being of rural households, causing a decline in agricultural productivity. Floods also cause labor migration from the agricultural to the other sectors, consequently impairing economic activities. Frequent floods pose a severe threat to agricultural production, introducing uncertainty in the livelihoods of small-scale farmers. Considering that food is a fundamental human need, the aftermath of flood events worsens challenges due to diminished availability, restricted access, and constrained utilization of food resources. The accurate detection of flooded areas will help stakeholders, policymakers, and water resources managers improve food security and public safety and mitigate the impacts of flood and associated socio-economic losses by undertaking strategic planning.

In this study, SAR data from the NASA Uninhabited Aerial Vehicle Synthetic Aperture Radar (UAVSAR) instrument were used for the rapid detection of flooded areas. For this purpose, many PolSAR decompositions (namely, Huynen, Freeman and Durden, Cameron, Touzi, Yamaguchi, etc.) were calculated and used as inputs in the deep Residual U-Net (ResU-Net) approach. The developed approach is tested over southeastern North Carolina for the 2018 Hurricane Florence. We identified the optimal decompositions that yielded the most accurate flood mapping. The results showed that the ResU-Net can accurately detect inundated areas by utilizing the most appropriate PolSAR features. PolSAR images from UAVSAR allowed mapping inundation areas with high spatial resolution and unique advantages over optical satellites, stemming from the ability of SAR signals to penetrate clouds and vegetation canopies. Accurate mapping of flood inundation from this study can increase agricultural productivity and food security, enhance public safety and resilience, and reduce damage to properties and farms.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management

Investigating the Effect of Invasive Plants-Derived Biochar on Heavy Metal Adsorption

Authors: *Blessing O Aleladia (Loyola University Chicago)*; Brian Ohsowski (Loyola University Chicago); Shane Lishawa (Loyola University Chicago); Thomas Marrero (Wakefield Biochar)*

Urban wetlands face heavy metal accumulation from road runoff, posing risks to larger water bodies. Invasive plants like hybrid cattail, often employed as hyperaccumulators in urban wetlands produce excess biomass, leading to contaminant re-deposition upon decay. Biochar efficiently absorbs heavy metals, but there is limited exploration of using invasive plant-derived biochar to address heavy metal accumulation in wetlands. My study aim to investigate the heavy metal adsorption efficiency of three distinct biochar feedstocks, with a primary focus on determining the optimal biochar feedstock type and application rate. The overarching goal is to curtail heavy metal accumulation in wetland ecosystems, thereby mitigating downstream pollution. The research is conducted within the controlled environment of a greenhouse at Loyola University Chicago, aiming to replicate authentic wetland conditions through the use of mesocosms. The study employs biochar sourced from three prominent invasive plant species—Typha × glauca (hybrid cattail), Phragmites australis (common reed), and Rhamnus cathartica (European buckthorn). Each biochar is pyrolyzed at 500°C and applied in seven replicates at rates of 0, 10, and 25 t/ha, ensuring a comprehensive exploration of the impact of varying application levels on heavy metal adsorption efficiency. To simulate real-world contaminated conditions, heavy metals—lead (Pb), arsenic (As), and chromium (Cr)—was added at a concentration 50% less than the EPA regulatory limit for heavy metals in agricultural soils. To enhance the ecological relevance, midway through the study, live cattails rhizomes are introduced. This addition allows for the assessment of the hyperaccumulation potential of live cattails in the biochar-amended environment, adding a dynamic biological dimension to the research. Data collection in this ongoing study involves periodic analyses of soil, biochar, and plant samples, utilizing advanced methods such as inductively coupled plasma mass spectrometry (ICP-MS) and Fourier transform infrared spectroscopy (FTIR). These techniques enable a thorough assessment of heavy metal content and distinct biochar quality, contributing to a nuanced understanding of the interactions between biochar, heavy metals, and the wetland environment. My study's hypothesis posits that Typha × glauca biochar will exhibit superior heavy metal adsorption. This hypothesis is grounded in distinctions in chemical composition, concentrations of functional groups, and structural variations that are anticipated to significantly impact adsorption efficiency.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management

Monitoring Field Scale Soil Moisture with sUAS Mounted L-band Radiometer

Authors: *Michael H Cosh (USDA-ARS-HRSL)*; Robin Kim (University of Virginia); Andrew Russ (USDA-ARS-HRSL); Bin Fang (University of Virginia); Runze Zhang (University of Virginia); Ziyue Zhu (University of Virginia); Venkat Lakshmi (University of Virginia)*

Field scale soil moisture estimates are useful for precision agriculture, modeling, and other climate smart decision support systems. Both monitoring via in situ or proximal sensors can be time consuming and expensive. Drone based systems are growing in popularity and with the reduction in size of many technologies, it is feasible to look forward to commercially available drone systems that can automatically monitor large scale soil moisture distributions in agriculture. One of these early systems was tested over the Lower Chesapeake Bay Long Term Agroecosystem Research Site. This system was used to track a soil moisture drydown in the spring of 2023, to establish the accuracy and viability of the platform. Field sampling with volumetric sampling and dielectric probes was conducted to provide a ground truth for comparison to the airborne estimate. Discussion of the limitations and advantages of the system will also be presented including potential improvements for future platforms.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management

The Arkansas Discovery Farm Program: Documenting the Impact of Poultry Litter on Water Quality and Soil Health in Rice Production

Authors: *Matthew Davis (University of Arkansas); Eric Simon (University of Arkansas); Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service); Jace Clark (Univiersity of Arkansas); Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service)**

The Arkansas Discovery Fam program helps farmers document the impact of conservation practices on their farm with respect to water quality, water use, soil health and climate change residency. The overall goal of the program is to document sustainable and viable farming systems that remain cost-effective in an environmentally sound manner on private, working farms so that farmers can educate other farmers. Interest in using poultry litter as a fertilizer source on row crops has grown exponentially in recent years in Eastern Arkansas as new poultry companies have located near the Mississippi Delta region of Arkansas. In response, the Arkansas Discovery Farm for Utilizing Poultry Litter on row crops was established in 2021. Edge of field monitoring of runoff water quality adhering to NRCS Conservation Activities 201 and 202 is being conducted on three rice fields that underwent land leveling, an approved NRCS practice, just prior to the initiation of monitoring. Additionally, selected chemical, hydro-physical and microbiological parameters are being monitored to determine the potential of poultry litter to improve soil health on land-leveled soils. The fields receive 2, 3 and 4 tons per acre of poultry litter annually prior to planting. During 2022 and through August of 2023, median total nitrogen (TN) losses per runoff event were 0.28, 0.42 and 0.24 lbs./A for 2, 3, and 4 ton/acre application rates, respectively while median total P (TP) losses per runoff event were 0.03, 0.08 and 0.07 lbs./A for 2,3 and 4 ton/acre application rates. Median TP losses tended to increase with application rate whereas TN did not. Monitoring results for nitrogen, phosphorus and potassium losses will be presented and discussed more thoroughly.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management

Western Lake Erie Basin - Manure Nutrient Recovery

Authors: *Rick BC Johnson (Applied Environmental Solutions)**

A Conservation Innovation Grant (CIG Grant) was secured from the USDA, NRCS by the Maumee Watershed Alliance to support this project which began April 25, 2022 and completed on February 19, 2024.

The project's objective was to investigate and advance the use of technologies that can economically recover nutrients, primarily phosphorus (P2O5) from animal waste to levels that can support the transportation and distribution of the now recovered nutrients on farm fields that can be utilized the for crop production, or potential resale. The technologies evaluated included the use of low cost dewatering of raw manure with a Kendensha Rotating Disc Separator (KDS) and the USDA patented QuickWash® suite of technologies, primarily for phosphorus recovery.

Manure nutrient levels vary greatly between the type of livestock being grown & livestock production method. One of the most common methods in the Midwest is under-building deep pit storage, especially for swine production. 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. If the livestock producer limits manure application to the required phosphorus levels for crop production, he most likely will need to supplement his crop nutrient program by applying the required additional nitrogen and potash. Some producers, especially in years past, have elected to apply additional swing manure to levels that now meet crop nitrogen needs, often resulting in an over application of P2O5.

Results from the completed program demonstrated the ability to recover up to 98.5% of available P2O5 through simple dewatering with supplemental polymer addition through use of a high molecular weight, mid-range cationic polymer. Further, slightly higher recovery (99.2%) was achieved with the QuickWash process and conventional dewatering of the raw manure. Economics for both processes will be shown which demonstrates these levels of P2O5 recovery at a cost comparable to conventional land application of manure.

Interestingly though, it was demonstrated that in conventional dewatering of raw manure, 65-75% of the ammonium (NH4) is still available. Using a second technology of the QuickWash suite, this ammonium was recovered in the form of ammonium sulfate, with a demonstrated recovery of 96.9%. Further, a recovery of ammonia as an initial hydrogen feedstock of 78.8% was also demonstrated.

Work is continuing to further enhance and demonstrate the ability to maximize the nutrient value of P2O5 and NH4 in the coming year.

Track: 2024 General Conference Theme

Subject: Water Resource Assessment and Management