SOIL AND WATER CONSERVATION SOCIETY

One World, Connected through CONSERVATION

2021 July 26-28 | Virtual Event
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ABSTRACT BOOK

TABLE OF CONTENTS

SYMPOSIA PRESENTATIONS

Tuesday, July 27

Symposia Session Descriptions and Agenda

Conservation Innovation Grants Program Overview and Stakeholder Updates and Improving Soil Health around the USA

Track: Conservation Innovation Grants Showcase

Time: 11:00 AM – 12:30 PM CT

Moderator: *Caroline Sherony, USDA NRCS*

The USDA Natural Resources Conservation Service (NRCS), in conjunction with SWCS, will host the CIG Showcase at the virtual 2021 SWCS International 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 focuses on soil health in locations from South Dakota to the Rio Grande Valley. The second panel explores CIG projects involving innovative tools and technologies across a variety of land uses. The final panel includes presentations from CIG grantees whose projects focus on bringing down barriers to implementing conservation activities—from urban gardening to conservation finance.

This showcase runs from 11:00 AM to 4:30 PM CT on Tuesday, July 27. CIG project posters will be showcased in the poster presentation tab during the duration of the event

Presentation 1: Conservation Innovation Grants Program Overview and Stakeholder Updates – *Caroline Sherony and Leah Hermens, USDA NRCS*

Presentation 2: Cover Cropping As a Double-Edged Sword: Tradeoffs between Soil Health and Soil Moisture on Water-Limited Farms in South Texas – *Mike Morris, National Center for Appropriate Technology; Alexis Racelis, University of Texas Rio Grande Valley*

Subtropical climates pose special challenges for cover cropping and other soil health improvement strategies because of the intense summer heat, humidity, and lack of killing freezes. Much of the research done in temperate regions simply does not apply to subtropical areas, which include many important agricultural regions. The Subtropical Soil Health Initiative was a four-year effort by the National Center for Appropriate Technology and University of Texas Rio Grande Valley to demonstrate ecological soil management in the Rio Grande Valley of South Texas: a semi-arid subtropical region where there has been little locally-relevant research. Adoption rates for cover cropping are extremely low in this region, and many dryland producers express concerns that moisture loss to cover crops will harm cash crop yields.

Our project answered many practical questions and generated considerable interest in cover crops among the mainly-Hispanic farmers in the area. We carried out controlled studies of over 40 cover crops, including some that are common in other subtropical parts of the world but unusual in Texas. Sunn hemp, sorghum sudangrass, and cowpea (among others) performed well in hot, humid conditions: suppressing weeds, adding biomass, and (in the case of the legumes) adding nitrogen. However, soil moisture monitoring partially validated producer concerns about cover crops "stealing moisture" from cash crops and negatively impacting cash crop yields. Soil moisture in cover crop plots was lower, on average, than in adjacent control plots in all three years of our study. Cover crops offered great benefits in the form of weed suppression and improved soil health, and we saw steady, gradual improvement in soil organic matter levels and water-holding capacity over the three years of our project. But these benefits must be weighed against potential losses of soil moisture—a major limiting factor of crop success for dryland farmers in semi-arid regions. Cover crops represent a risky and delayed return on investment for dryland farmers who lack irrigation access—making economic returns dependent on the timing of rainfall events. These risks can be mitigated through experimentation and careful attention to cover crop species, seeding rates, termination method, and other factors. However, the learning curve is steep and short-term costs and risks, including the risk of cash crop failure, understandably discourage many farmers from trying cover crops. We conclude that moisture management is a major obstacle to cover crop implementation in semi-arid regions. These findings also reinforce the importance of conservation cost-share programs like EQIP that reduce the up-front cost and risk to producers.

Presentation 3: Vegetation and High Rainfall Contribute to Improved Soil Health in a North American Northern Great Plains Saline-Sodic Soil – *Shaina Westhoff, South Dakota State University*

Co-Authors: *D.E. Clay, D.J. Fiedler, C.L. Reese, and S.A. Clay, (South Dakota State University*

To prepare agricultural producers and consumers for an unknown climatic future, understanding the interactions among salinity, sodicity, and climate change is imperative. The objective of this research was to determine the effects of vegetation and high rainfall on soil and plant health of a degraded saline-sodic soil. A four-year (2018 through 2021) replicated study was conducted in the North American Northern Great Plains (NGP). Four vegetation treatments (none, corn, and 2 perennial grass mixtures) were tested at three landscape positions (low productivity saline-sodic, transition, and high productivity). Following dormant seeding perennial grass in 2017, perennial grass yields (1,140 ld/a1) in 2018 were much less ($p<0.05$) than corn (9,900 kg ha^{-1}), whereas during the year of high spring rainfall (2019), perennial grasses (8,100 lbs/a) outproduced ($p<0.05$) corn (3,500 kg ha^{-1}). In 2020, all perennial vegetation treatments had similar ($p=0.39$) yields (6,800 lbs/a). The EC1:1, Na, and Na:EC1:1 ratio decreased in all landscape positions from 2018 to 2019. However, vegetation accelerated ($p<0.05$) the loss of Na relative to EC. These findings indicate that, in addition to covering the soil and providing living roots, plants reduced the risk of soil dispersion. From 2019 to 2021, EC1:1 increased by 1.62 dS/m, while the Na concentration (-175 mg Na kg^{-1}) and Na to EC1:1 ratio decreased [-147 (mg Na ×m) (kg ×dS)$^{-1}$] in the low productivity saline-sodic soil. Different results were observed in the highly productive soil where the Na to EC ratio increased. These

values suggest that vegetation in combination with high rainfall contributed to soil health improvements in a NGP saline-sodic soil, however these benefits may be short lived if adequate rainfall is not received.

Presentation 4: Measuring Soil Health in the Upper Midwest to Improve Water Quality – *Ann Marcelle Lewandowski and Hava K. Blair, University of Minnesota*

Soil health management in the upper Midwest is constrained by short growing seasons, cool soils, and areas of heavy, wet, clay-rich soils. Yet, comparatively little soil health data is available to understand the impact of management on the region's soils. In 2019, the Minnesota Office for Soil Health at the University of Minnesota initiated a collaborative research project aimed at supporting the adoption of soil health management systems in the Upper Midwest. This project brings together multiple university departments, local partners, and 25 farmer cooperators with the goal of improving our ability to evaluate and quantify the impacts of soil health management in both environmental and economic terms. We are achieving this goal through a combination of on-farm data collection, stakeholder engagement, and the development of multiple platforms for sharing soil health data. We completed two seasons of on-farm data collection to better understand soil health metrics in these conditions across a range of agronomic management practices. Our team is also investigating the relationship between management and soil water regulation functions through on-farm measurements of infiltration and simulated extreme rainfall events. To extend the long-term value and utility of the biophysical data collected, we developed a soil health data management system allowing us to continually add datasets from other researchers and publicly display combined summaries and analyses. The biophysical data is complemented by 25 detailed case study interviews with farmers that help us understand the social and economic drivers of soil health management decisions. The stories are shared through a farmer-to-farmer networking tool (FarmMaps).

90 Cover Crops in 90 Minutes

Track: 3, 2, 1 … ACTION!

Time: 11:00 AM – 12:30 PM CT

Moderator: *Keith Berns, Green Cover*

Presenter: *Dale Strickler, Green Cover*

Join us for a LIVE tour of Green Cover's cover crop plots and listen as industry experts, Keith Berns and Dale Strickler take you on a guided tour of more than 90 different cover crop species, mix combinations and biological demonstrations. Some of the more "exotic" plants to be covered will be: chia, sesbania, lab lab, sesame, okra, squash, gourds, spineless safflower and more! An extensive sorghum and millet evaluation plot section will also be featured. Mix combinations and biological additive trials will be looked at and discussed. A live link will allow you to ask specific questions about the species as we move through the plots! This is a rare opportunity to see this level of cover crop diversity and listen to expert analysis without having to travel!

A Walk Through the "Guide to Outcomes Estimation Tools," a Dive into a Do-It-Yourself Method to Estimate Water Quality Outcomes, and Helpful Tips from the Leading Tool Developers

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Moderator: *Michelle Perez, American Farmland Trust*

Presenters: *Cole, American Farmland Trust; Emily Bruner, American Farmland Trust; Ali Saleh, Tarleton State University; Eric Coronel, Field to Market*

Managers of the USDA NRCS Regional Conservation Partnerships Program (RCPP) and other landscape-scale projects want to estimate the water quality, climate, social, and economic outcomes associated with the adoption of conservation practices by farmers in their projects. However, many managers struggle to determine which modeling tool or method is right for their project and using an outcomes estimation tool can be very hard, especially for those without prior modeling experience.

To help, AFT identified, described, and compared readily available outcomes estimation tools and methods to educate conservationists and empower project managers to select one or more tools/methods to meet their project outcomes quantification goals. We reviewed 51 models, tools, and methods to see which would likely work for a project manager without requiring professional computer modeling experience. The Guide features seven water quality tools and one method, three climate tools, one social tool and one method, and three economic tools that provide quantitative estimates of outcomes, are available to the public and for use in more than one state.

Perez and Cole, Guide co-authors will first briefly walk attendees through tips on how to use the Guide. Next, they will compare and contrast tools featured in the Guide, including a comparison of those that are best suited for field- and site-specific outcomes estimation versus those developed to estimate project-level generalized outcomes. Then, Bruner will provide a deep dive into a do-it-yourself method to estimate water quality outcomes. Then, Saleh and Coronel will provide a quick overview of the Nutrient Tracking Tool (NTT) and the FieldPrint Calculator, respectively, and some “pro user tips” on how to maximize usability, emphasizing the strengths and drawbacks of selecting their tools for outcomes estimation.

Diversity: Connected through Conservation

Track: Justice, Equity, Diversity, and Inclusion

Time: 11:00 AM – 12:30 PM CT

Moderator: *Katrina Thompson, USDA NRCS*

Presenters: *Rosemary Abban, USDA NRCS; Angela Biggs, USDA NRCS; Sharon Nance, USDA NRCS; Bertha Venegas, USDA NRCS*

The panelists will lead a thought-provoking discussion on cultural diversity. We plan to show how the impact of inclusiveness can add value to the workplace environment and bridge the challenges of intersectionality when navigating the work life of conservationists connected through conservation.

Edge of Field in Action: A Discussion on Edge of Field Practices from Roadmap to Implementation

Track: One World, Connected through Conservation

Time: 11:00 AM – 12:30 PM CT

Moderator: *Kris Johnson, The Nature Conservancy*

Presenters: *Adrienne Marino, The Nature Conservancy of Illinois; Karen Wilke, The Nature Conservancy of Iowa; John Swanson, Polk County Public Works; Mary Beth Stevenson, City of Cedar Rapids; Caroline Wade, Ecosystem Services Market Consortium*

Last year, The Nature Conservancy (TNC) led a collaborative process with SWCS and Meridian Institute to create an Edge of Field (EoF) Roadmap. Together, along with industry experts, we assessed a variety of EoF practices and synthesized key information to identify barriers to and opportunities for the wide scale adoption of practices. Our goal was to develop a strategic roadmap with actionable recommendations to catalyze the adoption of practices through science, business, and policy levers.

EoF practices on agriculture lands play an important role in the health of our waterways. They are one part of a whole systems approach to sustainable agriculture that also includes in-field conservation practices and downstream floodplain protection and restoration. In addition to water quality benefits, EoF practices provide carbon storage, pollinator and wildlife habitat, flood storage, and streambank stabilization.

The Roadmap is grounded in a scientific literature review and an analysis of existing policies and programs to offer pragmatic, cost-effective recommendations. This roadmap complements TNC's 2016 reThink Soil Roadmap, a parallel strategy to facilitate the adoption of in-field practices. Together, these Roadmaps aim to advance positive change on working lands to deliver economic and environmental benefits to farmers and communities.

In this session, we will provide an overview of the Edge of Field Roadmap and present details from the scientific literature review that provided the foundation of the Roadmap. Then we will share information and stimulate discussion about on the ground projects and opportunities to scale up implementation efforts. In particular, we'll discuss the importance of public private partnerships and effective collaboration and will explore the potential for emerging ecosystem services markets and urban water quality incentive programs to support practice implementation.

Tools to Plan and Evaluate Soil Health Management Systems for Carbon Sequestration

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

Time: 11:00 AM – 12:30 PM CT

Moderator: *Bianca Moebius-Clune, USDA NRCS*

Presenters: *Rachel Seman-Varner, USDA NRCS; Skye Wills, USDA NRCS; Kristen Veum, USDA ARS; Adam Chambers, USDA NRCS; Dan Dostie, USDA NRCS; Mary Podoll, USDA NRCS*

Soil Health Management Systems (SHMS), as defined by the NRCS, have evolved from foundational concepts of soil conservation, soil productivity, and soil quality. SHMS focus on soil function and the processes connected to multiple provisioning, supporting, and regulating ecosystem services. Critical ecosystem services provided by SHMS are climate mitigation, adaptation and resilience. Some conservation practices included in SHMS sequester carbon and reduce greenhouse gases emission, while also allowing production systems to adapt and to be more resilient to climate extremes and changing weather patterns. Across NRCS and with other agencies and partners, the Soil Health Division supports the implementation of SHMS on the nation's working lands and the evolution of the science related to soil health assessment, evaluation, and development. Speakers in this symposium will address current collaborations and tools that are used in design and evaluate practices and systems that impact carbon sequestration. Topics will cover the Conservation Practice Database, Soil Health Demonstration Trials, Conservation Practice Standard (808) Soil Carbon Amendments, Dynamic Soil Properties Data Hub, Soil Health Assessment Protocol and Evaluation (SHAPE), COMET-Farm model focusing on the COMET-Planner application, and how these and other tools are applied. A panel discussion among presenters will facilitate development of ideas to integrate these and other tools, promote collaboration, and cross-promote related projects, and to promote use at the state and regional levels.

Presentation 1: Tools to plan and evaluate Soil Health Management Systems for Carbon Sequestration – *Bianca Moebius-Clune, USDA NRCS*

Co-Authors: *Rachel Seman-Varner, Brandon Smith*

Soil Health Management Systems (SHMS), as defined by the NRCS, have evolved from foundational concepts of soil conservation, soil productivity, and soil quality. SHMS focus on improving and maintaining soil function and the processes connected to multiple provisioning, supporting, and regulating ecosystem services. Climate mitigation, adaptation and resilience are critical ecosystem services provided by SHMS. Core conservation practices included in SHMS sequester carbon and reduce greenhouse gas emissions, while also improving resilience of production systems to better handle intense rainfall, heat, drought, and other impacts from volatile weather.

NRCS, in collaboration with other agencies and partners, supports the implementation of SHMS on the nation's working lands and the evolution of the science related to soil health assessment, management, evaluation, and development. Speakers in this symposium will address current collaborations and tools that are used to design and evaluate practices and systems that impact carbon sequestration. A panel discussion among presenters will address integration of these and other tools, promoting collaboration, cross-promoting related projects, and their use at the state, regional, and national levels.

Presentation 2: Soil Health Management Systems Conservation Activities – *Rachel Seman-Varner, USDA NRCS*

Co-Authors: *Bianca Moebius-Clune, Brandon Smith*

Soil Health Management Systems (SHMS) apply the four principles of soil health; maximizing cover, maximizing biodiversity, maximizing living roots and minimizing soil disturbance. The conservation planning activities associated with SHMS address soil health resource concerns such as soil organic matter depletion, aggregate instability and loss or degradation of soil organism habitat, among others. Many of the conservation practices implemented as part of a SHMS also sequester carbon. The application of soil carbon amendments is currently supported through an interim practice standard

(808), which provides financial and technical assistance. Additionally, the evaluation and monitoring of soil health indicators, including soil organic carbon, is supported through the Soil Testing Conservation Evaluation and Monitoring Activity. The information provided by participants in NRCS programs is used to evaluate the effectiveness of the practices on the identified resource concerns and will be integrated into a new Conservation Practice Database. Also, the results from Soil Health Demonstrations On-Farm Trials under the Conservation Innovations Grants program will be integrated into evaluation and interpretation tools. It is in the coordination of programs, planning, and data analysis and interpretation that NRCS will advance SHMS that build soil health and sequester soil carbon.

Presentation 3: The DSP Data Hub and Soil Survey Information – *Skye Wills, USDA NRCS*

Co-Authors: *Laura Morton, Jason Nemecek and Mike Robotham*

The Dynamic Soil Property (DSP) data hub is being developed by NRCS to support soil survey, soil health and other agency analysis needs related to changing soil properties with land use and management. The soil survey program measures DSPs through Major Land Resource Area Soil Survey Office projects with standard guidance and procedures to collect and store data. There are three tiers of data collection depending upon local interests, soil survey priorities and resources available. The Soil and Plant Science division also coordinates the Science of Soil Health Initiative and the DSP for Soil Health (#DSP4SH) projects. DSP4SH projects are

cooperator led Cooperative Ecosystems Studies Units projects that use DSP sampling and replication guidance and Soil Health Technical Note 450-03 methods. They cover a range of climate and soils and evaluate locally important management systems that fall in three big categories: Business as Usual (BAU), Soil Health Management (SHM) and Reference conditions. The same properties are being collected from Soil Health Demonstration Trials. All of these datasets can be collected, analyzed and interpreted in the DSP Hub according to approved models following strict data governance. The DSP Hub will support future soil survey products including expanded ecological sites, conservation, and decision support tools.

Presentation 4: Soil Health Assessment Protocol and Evaluation – *Kristen Veum, USDA ARS*

Co-authors: *Marcio Nunes, Doug Karlen, Skye Wills, Cathy Seybold, Scott Holan, Paul Parker, Harold van Es, and Joseph Amsili*

The response of dynamic soil properties to management and land use is dependent on site-specific factors. The Bayesian model- based Soil Health Assessment Protocol and Evaluation (SHAPE) tool was developed with the flexibility to account for the interaction of inherent factors of climate and soil properties when interpreting changes in dynamic soil health indicators based on a peer group approach. The SHAPE tool was initially developed for soil organic carbon (SOC) and has been expanded to include active carbon (ActC), autoclaved citrate extractable protein (ACE-Prot), and four-day carbon respiration (Resp). Data were compiled from the literature, the Cornell Soil Health Laboratory, and the Kellogg Soil Survey Laboratory. The SHAPE scoring curves for SOC, ActC, ACE-Prot and Resp have demonstrated sensitivity to management practices across multiple soil types and provide a regionally relevant interpretation of these key soil health indicators.

Presentation 5: COMET Tools – *Adam Chambers, USDA NRCS*

Greenhouse gas and carbon sequestration quantification tools enable USDA to evaluate and manage climate-smart conservation practice investments. These quantification tools also enable farmers, ranchers and private forestland owners to assess the atmospheric benefits of voluntary conservation practice implementation. Voluntary conservation practices are a climate solution. A select group of NRCS conservation practices are very effective at reducing greenhouse gas emissions and sequestering carbon in perennial biomass and healthy soils. The COMET tools (COMET-Farm and COMET-Planner) have been developed to help agricultural producers quantify emissions reductions and carbon sequestration. These tools also underpin the NRCS authoritative data sets for evaluating and reporting greenhouse gas emissions and carbon sequestration from implemented practices. In this session, we will discuss the role of the COMET tools in supporting agricultural producers as they implement Soil Health Management Systems and other climate smart agriculture practices, NRCS technical staff who

support producer implementation, and the National Inventory of Greenhouse Gas Emissions and Sinks that is submitted by the United States annually.

Presentation 6: National Conservation Initiatives and Farm Bill Program Implementation Opportunities – *Dan Dostie, USDA NRCS*

Farm Bill Program funding resources are available for helping individual farmers and ranchers, regional conservation partnerships, and other eligible entities implement planned practices or develop innovative technologies and approaches to accelerate Climate Smart Agriculture and Forestry.

Conservation planners and soil health specialists help their customers understand the landscape, assess the condition of natural resources there, identify resource concerns, and plan solutions to meet their objectives. Site specific practices targeted to meet critical conservation needs under expected volatile weather and changing climate conditions may be funded by Farm Bill programs or other financial resources. Through the Conservation Assessment Ranking Tool, NRCS evaluates the benefits of Soil Health Management Systems to its customers and broadly to all of society.

Presentation 7: NRCS Leading Change at the State Level with Customers and Partners – *Mary Podoll, USDA NRCS*

Mary Podoll, USDA-NRCS North Dakota State Conservationist will provide insight to current utilization of soil health and carbon sequestration tools by the NRCS field staff and partners. Building upon science and the current tools, there is expertise from USDA staff and experts around the world. Modernization of tools and training of staff and partners is a priority to lead the nation in climate mitigation, adaption, and resilience, and to ensure that measuring standards are quantitative and proven. USDA is well-positioned to lead Climate Smart Agriculture initiative with its voluntary locally led conservation model, its delivery system and its financial assistance programs. Innovative, cutting-edge, but practical science and technology is the key to Climate Smart Strategies. Relationships with farmers, ranchers and local agriculture and conservation organizations are critical to these efforts. Intentional thought to methodologies and decision making of farming and implementation of conservation planning will be instrumental to the overall global needs for climate change.

Innovative Tools and Technologies for Land and Water Management

Track: Conservation Innovation Grants Showcase

Time: 1:00 PM – 2:30 PM CT

Moderator: *Havala Schumacher, USDA NRCS*

The USDA Natural Resources Conservation Service (NRCS), in conjunction with SWCS, will host the CIG Showcase at the virtual 2021 SWCS International 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 focuses on soil health in locations from South Dakota to the Rio Grande Valley. The second panel explores CIG projects involving innovative tools and technologies across a variety of land uses. The final panel includes presentations from CIG grantees whose projects focus on bringing down barriers to implementing conservation activities—from urban gardening to conservation finance.

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Presentation 1: Promoting Sensor Based Technology to Improve Land and Water Resources Conservation – *Saleh Taghavaein, Oklahoma State University*

Implementing sensor-based technologies to improve land and water management has been researched for several decades and the potential benefits of sensors have been documented in many studies. However, only a small fraction of producers use them in their routine decision making. The goal of this CIG project was to promote the adoption and implementation of sensor-based technologies in irrigated agriculture to enhance irrigation management and land and water resources conservation. The project evaluated the accuracy of several commercially available sensors under field conditions and found that different sensors have different accuracies and variable responses to elevated levels of clay content and salinity. The project also established a demonstration network in west-central Oklahoma, where sensor technologies showed that almost all fields were under-irrigated. The results of this project were disseminated through 200 presentations and 17 publications.

Presentation 2: A New Transport x BMP-Based Phosphorus Index Approach for Identifying Fields with a High Risk of P Loss and Selection of BMPs for Manure Management Across the Northeastern United States – *Quirine Ketterings, Cornell University*

Co-Authors: *Karl Czymmek, Mart Ros, Martin Battaglia, Cornell University; Douglas Beegle, Pennsylvania State University; Peter Kleinman, USDA; Joshua Faulkner, Jeffrey Carter, University of Vermont; Amy Collick, University of Maryland Eastern Shore; Zach Easton, Virginia Tech; Masoud Hashemi, University of Massachusetts; Thomas Morris, University of Connecticut*

Most phosphorus indices (PIs) use a source x transport approach that determines a P source score (taking into account P source, method of application, rate and timing), which is then multiplied by a score that represents relative risk of P transport. In 2017, a new transport x BMP approach was proposed for New York where fields are ranked first based on relative transport risk (if manure were applied without BMPs) followed by selection of BMPs (credit system) from a list of option related to application method, ground coverage and timing of application. Final implications (no manure, rate limited to P removal equivalents, or N-based rates) depend on whether soil test P levels are within the agronomic range or higher (four soil test P based classification). This restructured approach has many benefits (more intuitive, places focus on high-risk fields, incentivizes BMP implementation) and reduces barriers to regionalization of PIs, as states can identify their own landscape risk factors, soil-test cutoffs, and BMPs while maintaining the same management categories. With current USDA-CIG funding (69-3A75-17-26) we explored the potential for this transport x BMP to be used in NY as well as across the Northeast. Planner surveys, stakeholder meetings, farm and field visits were combined with a soil test P comparison, modeling of manure BMPs for watersheds in NY, PA, and VT using SWAT-VSA, and evaluation of impact of a new PI on BMP selection and manure management on dairy farms in NY. The project showed the ability of the new PI approach to limit P applications on fields with high transport risk while incentivizing adoption of BMPs and improvements in whole-farm P management. Findings resulted in the release of NY-PI 2.0 which was added to the NY 590 nutrient management standard (2020 update) and will become part of comprehensive nutrient management plans for concentrated animal feeding operations (CAFOs) when NY's CAFO permit is renewed in 2022. Consulting firms in NY are currently implementing the NY-PI 2.0 into their software and 2021/2022 planning cycles. Discussions are ongoing with counterparts in the New England states to evaluate the possible adoption of the transport x BMP approach across the region.

Presentation 3: Using Farmer-Based Water Technology Farms to Implement New Irrigation Technologies to Sustain the Rural Economy – *Jonathan Aguilar, Kansas State University*

The High Plains Aquifer of western Kansas supports more than a third of total agriculture revenue of the state is being depleted rapidly. To cope with limited water and to sustain the agricultural industry in western Kansas, producers are seeking new methodologies and technologies to limit economic decline and extend the useable aquifer life which includes improved water conservation technologies, more efficient irrigation applications and use of deficit irrigation management strategies. Among others, the goal of this project is to demonstrate and evaluate the management practices that a producer with an existing center pivot system will have to make in converting to an improved mobile drip irrigation (MDI) system and upgrade the irrigation decision support software for use on new delivery platforms. To date, this project was able to engage with several producers using the MDI system and assess this system against the typical sprinkler packages. Initial results have been shared in field days, groundwater management district's annual meetings, Central Plains Irrigation Conferences and Governor's Water Conferences to name a few. The KanSched irrigation scheduling tool was improved to cater irrigators using mobile devices. This project became instrumental in the

inception of another CIG project and the improvement of the installation design of the MDI system.

Presentation 4: RangeDocs: Enhancing Access to Key Rangelands Resources through A Rangeland Thesaurus and Improved Search Technology – *Jason W. Karl, University of Idaho*

Co-Authors: *Amber Dalke, Sean Di Stefano, Barbara Hutchinson, Jeremy Kenyon, Matt E. King, Karen Launchbaugh, Sheila Merrigan, Jeanne Pfander, Matt Rahr, Eric Winford, University of Idaho*

Successful rangeland management rests in the hands of well-informed land managers. When producers, conservation planners, and other stakeholders can quickly locate and access relevant information, they can make better decisions. The development of systems to organize and deliver knowledge to support adaptive rangeland management has been identified as one of the grand challenges to maintaining resilient rangeland systems. Organization of such information systems, however, is hindered by the distributed nature of resources across the internet and the lack of consistent and efficient search platforms. Topic-specific portals like GlobalRangelands.org (now RangelandsGateway.org) aggregate resources from disparate sources, but a standard vocabulary and directed tagging of resources is needed to improve relevance of search results. To meet the grand challenge of delivering accurate, relevant, and timely information to grazingland professionals, we developed RangeDocs as part of the new Rangelands Gateway portal as a new approach to efficiently discovering, locating, and saving handbooks, technical notes, and other reference materials. Three key features set RangeDocs apart from other document search sites: 1) it is built on a rangeland-specific thesaurus of terms harmonized from multiple sources such as the SRM Glossary and the NRCS Range and Pasture Handbook, 2) it contains the most relevant and useful resources as identified by agency staff and Extension specialists across the western US, and 3) it leverages paragraph-level annotations of core rangeland management concepts to get users quickly to the most relevant information they are searching for. The RangeDocs project is led by the University of Idaho and University of Arizona in cooperation with the Rangelands Partnership, a collaborative of range extension professionals and librarians from 19 states in the western US.

Virtual Tour of Water Quality Research in the Iowa River's South Fork Watershed

Track: 3, 2, 1 … ACTION!

Time: 1:00 PM – 1:45 PM CT

Moderator: *Kevin Cole, USDA ARS*

Presenter: *Allisyn Stanfield, USDA ARS*

The South Fork of the Iowa River watershed is a USDA Conservation Effects Assessment Project (CEAP) watershed located in north-central Iowa. The landscape is gently rolling and poorly drained, comprised of 'recent' glacial deposits (approx. 12,000 years). Agricultural drainage systems installed in the early 1900s have allowed the original wetland and prairie soils to become among the world's most productive agricultural lands; today about 90% of this 200,000-acre watershed is in crop production. Water quality issues, particularly high loads of nitrate nitrogen, were identified in the mid-1990s through stream monitoring conducted by the US Geological Survey under the National Water Quality Assessment (NAWQA). The USDA Agricultural Research Service's National Laboratory for Agriculture and the Environment (NLAE) extended stream and tile monitoring efforts in the early 2000s, leading to the South Fork of the Iowa River Watershed being designated as a CEAP watershed around 2004. The virtual tour will explore the water quality monitoring stations that have been designed to quantify nutrient and sediment transport. The virtual tour will include drone captured video following the flow of water from farm field to the stream monitoring station. Monitoring stations collected data by using sensors and water samplers. Sensors have included turbidity, conductivity, dissolved oxygen, nitrate, phosphate and stage. Samples were collected automatically during runoff events and weekly visits. Those samples were analyzed by NLAE for nitrate nitrogen, total phosphorus, ortho phosphorus and suspended sediment. Stations were established to better understand the variability of transport with drainage area from edge of field, field tile, tile drainage district to large basins. Videos will be presented of field activities at a stream monitoring station. Summary nutrient data from the last twenty years will be presented.

Big Solar: Stormwater Impacts and Sheep Grazing Interactions

Track: Adapting Landscapes to Climate Change

Time: 1:00 PM – 2:30 PM CT

Moderator: *Brian Ross, Great Plains Institute*

Presenters: *David Mulla, University of Minnesota; Jake Janski, Minnesota Native Landscapes; Jennifer Daw, National Renewable Energy Lab*

Wind and solar energy are now the least expensive form of electric energy generation in world, including in the U.S. Consequently, the market for renewable energy projects is surging, with large-scale projects being proposed in every state in the nation. Large-scale PV solar projects, in particular, present unique and uncertain risks and opportunities to water quality and watershed functions. The U.S. Department of Energy has funded the Photovoltaic Stormwater Management Research and Testing (PV-SMaRT) project to evaluate water quality impacts of large-scale solar development and the Minnesota Department of Agriculture has funded research to determine the effects of prescribed sheep grazing on plant diversity and density within a solar array. The PV-SMaRT study will create solar-specific runoff co-efficients that consider type of ground cover, soil type, hydrology, slope, and solar array design based on field testing across the nation and 3-D modeling. The grazing study will help inform best management practices.

PV-SMaRT field research focuses exclusively on the impact of ground cover choices and use of disconnection to mitigate for the volume and velocity at the drip edge of the panel. Ground cover choices have mitigating effects, but which could vary substantially under different site conditions, site designs, and design storm events.

One potential implication of the studies is understanding the conditions under which conversion of agricultural or disturbed land to solar development with appropriate ground cover could meet green infrastructure goals of improving water quality outcomes within impaired watersheds.

Cover Crops: Innovation in Policy Incentives through State Crop Insurance Premium Discounts

Track: Conservation Economics and Policy

Time: 1:00 PM – 2:30 PM CT

Moderator: *Kris Reynolds, American Farmland Trust*

Presenters: *Lara Bryant, Natural Resources Defense Council; Sarah Carlson, Practical Farmers of Iowa; Tim Fink, American Farmland Trust; Max Webster, American Farmland Trust; Ben Gramig, University of Illinois*

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 a $5 per acre discount on their crop insurance. In 2020, the Illinois Department of Agriculture followed suit. This symposium will discuss the state crop insurance incentive programs from their genesis to implementation and look forward to the future expansion of similar incentives across the nation. First, we will hear the behind-the-scenes genesis story of the Iowa and Illinois crop insurance programs from the policy advocates who worked with state agriculture departments and USDA to launch and promote the programs. On-the ground-experts in Iowa and Illinois will discuss the program details and how implementation has evolved since 2018, including the programs' challenges and lessons for success. Then, we will hear about program evaluation and lessons learned from the results of program evaluation surveys conducted by Iowa State University and the University of Illinois. Panelists will share the details of how the surveys were created and distributed to farmers in each state 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 impacts of the programs. Finally, we will discuss how to meet future demand for participation in the programs. Demand in Illinois, in particular, greatly exceeded available funds. What steps can policy advocates take to make these types of incentives available for more farmers, and what would that mean for increased cover crop adoption and the associated environmental benefits?

Strengthening the Heart of Conservation in the North Central Region of the United States and Mississippi River Basin

Track: One World, Connected through Conservation

Time: 1:00 PM – 2:30 PM CT

Moderator: *Rebecca Power, University of Wisconsin-Madison Division of Extension*

Presenters: *Jenny Seifert, University of Wisconsin-Madison Division of Extension; Mark Burbach, University of Nebraska-Lincoln; Jane Frankenberger, Purdue University; Todd Sutphin, Iowa Soybean Association*

People – our choices, our relationships with each other and the planet, and our institutions – are the heart of conservation. New tools, technologies, policies, and approaches are exploding onto the conservation scene. More than ever, conservation professionals, farmers, and other conservation leaders need timely and effective access to information, training, peer-learning and networking opportunities, and heart-felt support for what is often a long-term commitment to caring for land, water, and community in the places we live and work. This symposium will make the case for expanded investment in people as part of an overall theory of change for getting to scale in watershed management; present the results of a survey of watershed professionals in the Upper Mississippi River Basin; present three watershed training and peer learning programs; and provide time for participant discussion of critical needs for supporting watershed leaders. Programs featured will include the Sand County Foundation led Leadership for Midwestern Watersheds, the Nebraska Water Leaders Academy, the Indiana Watershed Leadership Academy, and some new efforts to expand farmer leadership in watershed management beyond the farm gate in the Mississippi River Basin. Presenters will cover theoretical foundations, program delivery and results, as well as future directions.

Bringing down Barriers through Social and Economic Investment

Track: Conservation Innovation Grants Showcase

Time: 3:00 PM – 4:30 PM CT

Moderator: *Lucas Isakowitz, USDA NRCS*

The USDA Natural Resources Conservation Service (NRCS), in conjunction with SWCS, will host the CIG Showcase at the virtual 2021 SWCS International 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 focuses on soil health in locations from South Dakota to the Rio Grande Valley. The second panel explores CIG projects involving innovative tools and technologies across a variety of land uses. The final panel includes presentations from CIG grantees whose projects focus on bringing down barriers to implementing conservation activities—from urban gardening to conservation finance.

This showcase runs from 11:00 AM to 4:30 PM CT on Tuesday, July 27. CIG project posters will be showcased in the poster presentation tab during the duration of the event

Presentation 1: Sustainable Conservation Investment Fund: An Impact Investment Approach for Chesapeake Farms and Forests – *Craig Highfield, Alliance for the Chesapeake Bay*

Co-Author: *Jenny McGarvey, Alliance for the Chesapeake Bay*

There is increasing and considerable potential for Maryland and Virginia agricultural landowners to participate in environmental markets to help fund their conservation work and sustain their economy. However, the required up-front costs needed to establish environmental service credits prohibits participation by many. In addition, there is a lack of reliable and easy to understand informational resources available to landowners who wish to participate in these environmental markets and an insufficient number of service providers in the region available or capable to guide interested landowners through the process.
During this project the Alliance and partners provided technical assistance and established the Chesapeake Forest Fund, a revolving loan tool, to help producers overcome the barriers associated with participating in Maryland's Forest Conservation Banking Program and Virginia's Nutrient Trading Program. We also conducted a series of collaborative workshops and trainings for land trusts, conservation organizations and technical service providers to introduce these conservation markets, while also hosting a roundtable that brought together public agencies, NGO's and private conservation investment sector to discuss regional conservation finance opportunities. We also equipped our online conservation tool, LandServer, to be able to report on conservation market eligibilities for queried land parcels.

This project resulted in five new Forest Conservation Banks and one Nutrient Bank developed on agricultural lands that established 55 acres of new, permanently protected forests. Approximately eighteen credits from these banks have already been transacted and the proceeds reinvested to establish two additional forest banks.

Presentation 2: Growing for Chicago – *Bradley Roback, City of Chicago*

The Growing for Chicago program was developed to help increase the number of urban farms, community gardens and urban growing spaces in Chicago and to provide training and resources to urban growers to help expand the urban agriculture system. The program had three main components that included:

1. Hiring a full-time urban agriculture program manager to help the City address issues related to urban growing and work with growers of all levels to establish productive landscapes.
2. Creating a program to train and provide technical assistance for urban growers to create, refine and implement their business plans through a cohort-based training model.
3. Developing urban farming spaces in historically underserved areas for community-based farmers, organizations, and residents to grow food and provide programming.

City of Chicago staff will provide an overview of the accomplishments and lessons learned over the course of the implementing the grant.

Presentation 3: Enabling Healthy Food Production, Soil Restoration, and Water Quality Improvement through the Establishment of Secure and Sustainable Farmland Access Tenures – *John Steven Bianucci, Iroquois Valley Farms*

Co-Authors: *David Miller, Fany Bortolin, Iroquois Valley Farms*

Iroquois Valley's 2016 Soil Restoration Note attracted private capital off the sidelines and into the conservation finance marketplace by offering a Debt Note instrument and organic transition pool, supporting farmers throughout their three-year organic transition.

By 2018, it was painfully clear organic farmer operating capital needs were not being met through conventional finance relationships, much less the financing of expanded conservation practices. We developed a 3-yr revolving operating loan, custom-tailored to each farm family's specific history and expansion goals and began underwriting and approving these credit lines.

With the support of Iroquois Valley's CIG19, integration of farm production with expansion of conservation practices is underway. We're funding conservation through new markets working capital loans. We're aligning conservation finance with farm conservation revenue.

We are building upon a Conservation & Assessment Reporting process integrated within the Company's farmer intake and financial underwriting process. We will be expanding effectiveness through internal farmer-management of a technical advisory community support network. Our process includes monitoring soil health and other ecosystem quality levels from baselines measured, establishing a positive relationship between financial credit quality and conservation practice quality.

Through various financial instruments, in the marketplace and under development, we intend to make available to organic farmers up to $25 million in Working Capital Loans and attract structured catalytic capital from nonprofit and financial investment communities.

As of May, 2021, the Company has approved and funded 7 operating lines of credit totaling over $1.5M dollars. The Conservation Assessment and Reporting process has been developed and integrated into our Farmer Intake, Underwriting and Investment Committee processes. A pilot concessionary capital Working Capital Farm Note has been sold to one of the oldest and largest reinsurance companies in the world.

Presentation 4: Providing Economic Evidence for Soil Health Investment: Case Studies, Predictive Assessments, and 3 Economic Tools – *Michelle Perez, American Farmland Trust*

Co-Authors: *Florence Swartz, Consultant; Ellen Yeatman, Dr. Emily Bruner, Brian Brant, Aaron Ristow, Paul Lum, Sarah Blount, Jean Brokish, Justin Bodell, Kris Reynolds, American Farmland Trust; Dr. Sat Darshan Khalsa, UC Davis*

One barrier preventing farmers from adopting soil health practices is the lack of evidence that soil health management systems (SHMS) do provide net positive economic and environmental benefits. AFT tackled this problem by demonstrating that investments in SHMS by nine farmers in four states has been worth the risk. (For more project background: https://farmland.org/project/quantifying-economic-and-environmental-benefits-of-soil-health/.) With external reviews provided by NRCS economists, soil health specialists, and university researchers, we published nine, easy-to-read and compelling two-page AFT-NRCS case studies that quantify the costs and benefits reported by "soil health successful farmers" in California (almonds), Illinois (corn-soy), Ohio (corn-soy), and New York (diversified). We also used USDA's Nutrient Tracking Tool and COMET-Farm Tool to estimate the water quality and climate outcomes achieved by these nine farmers through SHMS adoption. (The case studies are found on this AFT website: https://farmlandinfo.org/publications/soil-health-case-studies/) and on two NRCS sites: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/health/?cid=NRCSEPRD1470394; https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/technical/econ/data/?cid=nrcseprd1298423.) To empower our fellow conservationists to conduct their own case studies showing "farmers in their neck of the woods" that "it will work here," we released 20 resources in a Soil Health Economic and Environmental Tool Kit, including our Excel-based Retrospective-Soil

Health Economic Calculator (R-SHEC) (https://farmland.org/soil-health-case-studies-methods/). We are hopeful the public, private, and non-profit members of the farm conservation community will use these case studies as new "tools in their conservation toolbox," making their education and outreach efforts with farmers even more effective. And we are hopeful that farmers and their advisors will read the case studies and be convinced that investing in soil health *can* pay for itself. Between the release of the first set of case studies on July 30, 2019 and March 31, 2021, 8,095 unique individuals have visited AFT's project website, and 4,407 unique persons have downloaded one or more case studies 4,970 times. In addition, 290 unique persons (thru March 31, 2021) have downloaded the Tool Kit materials since the Tool Kit was released October 29, 2020. We are currently working towards a public release of a new Excel-based Predictive-Soil Health Economic Calculator. The P-SHEC tool estimates the potential, future short-term and long-term economic costs and benefits that "soil health curious farmers" could experience from their investment in soil health. Finally, we have developed an online version of the tools that is simpler and hopefully easier for farmers and their advisors to use to aid decision-making. We are looking for new sources of support to enter the pilot testing phase of the online tool with farmers and advisors, to make sure it meets their needs, and to support its continuous improvement and long-term maintenance.

Outreach in the Time of Covid: A Comprehensive Guide to Hosting Virtual Engagement Incorporating Soil Health Demonstrations

Track: 3, 2, 1 … ACTION!

Time: 3:00 PM – 4:30 PM CT

Moderator: *Ashley Brucker, American Farmland Trust*

Presenter: *Stephanie McLain, USDA NRCS*

Organizations such as American Farmland Trust and the Natural Resources Conservation Service have been leaders in engaging farmers and landowners in conservation implementation. With the onset of COVID-19 outreach and education was heavily impacted. Many halted their efforts altogether while others sought alternative methods to continue impacting change in agricultural communities. An obvious shift was to virtual platforms for meetings and educational webinars. Through trial and error, participant feedback and varied experience we have begun to master the art of not only leading engaging virtual events but also incorporating impactful demonstrations. We will be sharing a comprehensive guide on how to facilitate effective outreach using virtual platforms. Through the session we will also be exemplifying proper techniques and step by step guidance on performing soil health demonstrations online such as slake demos, slump tests, rain fall simulators and cover crop talks. In our final segment of the symposium, we will acknowledge challenges and lessons learned in working through virtual platforms. We will also trouble shoot issues from our attendees and offer up creative solutions for outreach in the time of Covid.

Exploring Metrics with the Hypoxia Task Force

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM – 4:30 PM CT

Moderator: *Max Potthoff, US EPA*

Presenters: *Katie Flahive, US EPA: Adam Schnieders, Iowa DNR*

The Mississippi River/Gulf of Mexico Hypoxia Task Force (HTF) is a partnership of 5 federal agencies, 12 states, and a tribal representative, who work together collaboratively and voluntarily towards the goals of the Task Force. The HTF formed and adopted their long-term, large-scale challenge of reducing nutrient loss in the Mississippi/Atchafalaya River Basin (MARB) in order to reduce the size of the hypoxic zone in the northern Gulf of Mexico. The goal of the Hypoxia Task Force is to reduce the 5-year average areal extent of the hypoxic zone in the Gulf of Mexico to less than 5,000 square kilometers by 2035, with an interim target for reducing total nitrogen and total phosphorus loads by 20 percent by the year 2025. This water quality goal is important, and the HTF also recognizes the need to see change more rapidly and locally, too.

Peer-to-Peer Learning about Farmer-to-Farmer Learning: Best Practices, Pitfalls, and Promising Ideas

Track: Outreach, Education, and Community Engagement

Time: 3:00 PM – 4:30 PM CT

Moderators: *Jenny Seifert, University of Wisconsin-Madison Division of Extension/North Central Region Water Network; Anne Nardi, University of Wisconsin-Madison Division of Extension/North Central Region Water Network*

Presenters: *Jessica Espenshade, National Wildlife Federation; Whitney Prestby, University of Wisconsin-Madison Extension Natural Resources Institute; Richard Sloan, Farmer, Lime Creek Watershed Council; Landon Yoder, Indiana University*

There is a groundswell of interest in facilitating farmer-to-farmer learning about conservation practices. Research and practice show the power of peers in influencing farmers' decisions. Farmers value what their peers think and do, especially those who have been there and done that. Outreach professionals across sectors are thus running programs to help farmers learn from each other. There is much outreach professionals and farmer leaders can learn from one another about running these programs effectively.

This symposium will be a chance for conservation professionals to do their own peer-to-peer learning about best practices, pitfalls, and promising ideas in farmer-to-farmer engagement. We'll address questions such as how can we 1) apply the science behind peer learning, 2) better engage the elusive "middle adopters," 3) address leadership fatigue among already dedicated farmers, and 4) overcome peer-to-peer barriers, such as competition and fear of being a black sheep.

A panel discussion with four professionals who are steeped in farmer-to-farmer learning will set the stage with their methods and results. Extension educator Whitney Prestby uses social media and video to help farmers in Wisconsin's Lower Fox Demonstration Farm Network share their insights. Jessica Espenshade leads National Wildlife Federation's Cover Crops Champions program, which empowers farmers to be ambassadors to their peers, and their Grow More training to improve engagement with middle adopters. Social scientist Landon Yoder studies how peer networks influence farmers' decisions. Richard Sloan, Iowa farmer and conservation leader, works with Practical Farmers of Iowa, Iowa Learning Farms, and other organizations to help farmers adopt conservation practices.

Through Q&A and prompted chats, we will also exchange ideas and questions from our own experiences. You will leave with new ideas from fellow professionals to apply to your efforts to empower farmers to be part of the solution.

Opportunities and Challenges Promoting US Soil Information Technology Globally: Cacao for Peace – Colombia

Track: One World, Connected through Conservation

Time: 3:00 PM – 4:30 PM CT

Moderator/Presenter: *Charles Kome, USDA NRCS*

The USDA-NRCS collaborated with the Pennsylvania State University (PSU) and the International Center for Tropical Agriculture (CIAT) (with Colombian Ministry of Agriculture and partners) in conducting a pilot soils investigation in the Sierra Nevada de Santa Marta region in North Eastern Colombia. The objectives of the project were to build capacity for the Colombia Ministry of Agriculture and partners to conduct soil and cocoa inventories at scales suitable for land management. In addition, there was a desire by the Colombian government to develop interpretive products such as cocoa planning area suitability maps to promote cocoa productivity through intensification. Soil and cocoa leaf samples were collected from a total of 249 farms in three cacao farming communities (the Arhuaco Reservation – Katansama (148), Guardabosques de la Sierra Producer Association (66), and Dibulla Organic Producers Association (35). Samples were analized and processed to obtain the following: NRCS, in collaboration with partners, developed a general soil map, several soil property maps, and a comprehensive cacao suitability map (1:25,000 scale). Other soil information products (accessible via computers or cell phones) include: comprehensive soil biological, chemical and physical properties for the sampled area; Arc- GIS Web Tool for Soils and Cocoa genomics in (English: Web Map-Cacao for Peace: https://arcg.is/1HmGrL ; and Spanish: Mapa Web-Cacao para la Paz: https://arcg.is/qyCWz) accessible to all; Colombia-specific soil erosion demonstration tool; and multicriteria cocoa suitability maps included in the " Soil and Cacao Genomics Survey of Sierra Nevada de Santa Marta Region, Colombia" report. This project was funded by USAID and facilitated by FAS.

Wednesday, July 28

Symposia Session Descriptions and Agenda

Improving Water Quality in the Upper Snake-Rock Conservation Effects Assessment Project

Track: 3, 2, 1 … ACTION!

Time: 11:00 AM – 11:25 AM CT

Moderator/Presenter: *Dave Bjorneber, USDA ARS*

The Upper Snake-Rock (USR) watershed is located in southern Idaho and is part of the USDA ARS Conservation Effects Assessment Project (CEAP), which focuses on water quantity and quality monitoring in the 82,000 ha Twin Falls irrigation tract. The Twin Falls Canal Company (TFCC) has been diverting irrigation water from the Snake River and delivering it by gravity to farms since 1905. The hydrology in this watershed is highly managed because the amount of irrigation water diverted into the watershed is five times greater than annual precipitation. Most streams only flow during the irrigation season. A portion of unused irrigation water, runoff from furrow irrigated fields, and subsurface drainage returns to the Snake River.

Sediment in irrigation return flow, primarily from furrow irrigation erosion, was a chronic problem in the Twin Falls irrigation tract. Cooperative efforts by TFCC, conservation districts and state agencies have dramatically improved water quality by converting to sprinkler irrigation, installing water quality ponds, and improving irrigation practices. In 1971, 460 kg/ha of sediment were lost from the watershed annually. Currently, more sediment flows into the watershed with irrigation water than returns to the Snake River. This virtual tour will highlight the irrigation distribution system, unique drainage tunnels, and implemented conservation practices.

Virtual Field Day: Increasing Wetlands and Oxbows = Improved Water Quality and More Wildlife

Track: 3, 2, 1 … ACTION!

Time: 11:25 AM – 12:30 PM CT

Moderator: *Ann Staudt, Iowa Learning Farms—Iowa State University*

Presenters: *Matthew Helmers, Conservation Learning Group—Iowa State University; Kay Stefanik, Iowa Nutrient Research Center & Conservation Learning Group—Iowa State University; Adam Janke, Conservation Learning Group—Iowa State University Extension and Outreach; Jake Hansen, Iowa Department of Agriculture and Land Stewardship—Water Resources Bureau*

The Iowa Learning Farms, in partnership with the Conservation Learning Group and the Iowa Nutrient Research Center will be presenting a virtual field day on the benefits of increased wetlands and oxbows in the Midwest. Join us as we explore a few different wetlands and oxbows in the state, look at funding programs and hear about the water quality benefits. In addition, we will look at how these wetlands and oxbows can add needed wildlife habitat in key locations. This highly interactive virtual field day will be a discussion between landowners, scientists, and wildlife specialists and all the participants at the session. The virtual field day will have video from the specific sites and we will also feature a short video of the Iowa Learning Farms new Wetlands Conservation Station that started rolling across Iowa in June 2021.

USDA Climate Hub Adaptation and Mitigation Showcase

Track: Adapting Landscapes to Climate Change

Time: 11:00 AM – 12:30 PM CT

Moderator: *Caiti Steele, Southwest Climate Hub*

The USDA Climate Hub network strives to develop and deliver science-based, region-specific information and technologies so that agricultural and natural resource land managers are empowered to make climate-informed decisions. The program does this by connecting USDA Research Agencies to Program agencies to build resilience to a changing climate. The Climate Hubs Program, established in 2014, is addressing the impacts of climate change on working lands via science synthesis, stakeholder engagement and technology transfer at 10 Hubs across the nation. In this symposium, we highlight novel regional solutions for climate adaptation and mitigation. Our short presentations highlight responses to climate impacts and extremes in critical topics such as water resources in the Southeast, soil health in the Southern Plains, climate-informed county planning in the Northeast, preparing for wildfire in the West, managing forests for multiple benefits in Puerto Rico and more. A short topical discussion session will follow each regional lightening presentation.

Presentation 1: Introducing the USDA Climate Hub Network – *Lauren Parker, California Climate Hub*

Presentation 2: Preparing for Wildfire and Drought in a Changing Climate – *Jessica Halofsky, Northwest Hub*

Presentation 3: Disturbance Impacts and Management Adaptation on Water Resources – *Emile Elias, Southeast Hub*

Presentation 4: Managing Soil and Water Conservation under Extremes: Supporting Decisions in the Midwest – *Dennis Todey, Midwest Hub*

Presentation 5: Economics of Climate Smart Soil Health Practices in the Northeast – *L. Knight, Northeast Hub*

Presentation 6: Opportunities and Barriers to Adopting Soil Health Practices as Natural Climate Strategies in California – *Devon Johnson, California Climate Hub*

Presentation 7: Land Management Strategies for Climate Adaptation in the Southern Plains – *Clay Pope, Southern Plains Hub*

Presentation 8: Innovative Agro-Climate Resources for the Great Plains – *Dannele Peck, Northern Plains Hub*

Presentation 9: Supporting Ashland County LWCD: Integration of climate Adaptation into County Planning – *Dannielle Shannon, Northern Forests Hub*

Presentation 10: Building a New "Forest Culture" in the Caribbean to Better Manage for Ecosystem, Economic, and Cultural Benefits from Forests – *William A. Gould, USDA Caribbean Climate Hub*

Presentation 11: Peer-to-peer drought response in the Southwest – *Emile Elias, Southwest Hub*

Ecosystem Services Market Consortium (ESMC): Enrollment Specialist Training for ESMC's Market Program

Track: Conservation Economics and Policy

Time: 11:00 AM – 12:30 PM CT

Moderator: *Caroline Wade, Ecosystem Services Market Consortium*

Presenters: *Stacy Cushenbery, Ecosystem Services Market Consortium; Neville Millar, Ecosystem Services Market Consortium*

ESMC is a non-profit, member-based, organization that will launch a national scale ecosystem services market program for agriculture in 2022. This program will pay farmers and ranchers for quantified, verified, certified, and outcomes-based soil carbon, net greenhouse gases, water quality and water conservation credits and assets generated from regenerative agricultural practices. Enrolled farmers and ranchers will play an important role in improving agricultural system resilience and mitigating climate change, while being recognized and paid for their services.

Producer participation and comfort with this market program is essential. As part of this program, ESMC is developing materials to help train ESMC Technical Enrollment Specialists who will guide, advise, and help enroll prospective farmers and ranchers into the program. This session will guide SWCS members through these enrollment materials, provide an opportunity for feedback on ESMC's training, and help participants better understand ESMC's market program.

As ESMC works towards a national market launch, we look to partner with SWCS to offer this Technical Enrollment Service training. The technical assistance expertise offered by SWCS members has added value that can help advise producers on further optimizing their management systems, potentially generating additional environmental benefits through ESMC's market-based program.

Missing in Action: A Failure to Deploy Women Landowners

Track: Justice, Equity, Diversity, and Inclusion

Time: 11:00 AM – 12:30 PM CT

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

Presenters: *Ed Lotterman, Lotterman Farm; Dan Zinkand, DZC, LLC*

Any initiatives to advance goals for agricultural conservation to address food security, climate change, complex water issues, and rural community resilience must address the greater diversity of decision makers including women landowners. In Iowa alone the value of land owned or co-owned by women exceeds $100 billion. Yet major government, Agribusiness, and most non-profit organizations pay little or no attention to women who own farmland. And all too often they are lumped in with 'landlords' even though the landlord is, in fact, often a woman. This session will discuss the system-wide gaps identified using Institutional Ethnography. These gaps lead to the omission of women landowners from active roles they could and increasingly want to play in reaching soil health and eco-agricultural goals. This could be class action brought to service for good.

Integrating Climate Benefits into Conservation Planning: Engaging Local, Regional and National Communities of Practice

Track: One World, Connected through Conservation

Time: 11:00 AM – 12:30 PM CT

Moderator: *Emily Bruner, American Farmland Trust*

Presenters: *Jennifer M. Moore, USDA ARS; Jean Brokish, American Farmland Trust*

Accelerated adoption of soil health practices on cropland and grazing land offers an unparalleled opportunity to combat climate change, improve water quality, and build on-farm resilience and profitability. Despite a recent uptick in practice adoption, fewer than a third of the 260 million acres in US row crops are managed with no-till, while less than five percent use cover crops, according to the 2017 Census of Agriculture.

American Farmland Trust recently released a report summarizing the technical capacity of cover cropping and no-till to sequester carbon and reduce greenhouse gas emissions (GHGs), providing a comparison of GHG emission reduction coefficients from previous metanalyses and modeling studies conducted across the US. We also used the Carbon Reduction Potential Evaluation (CaRPE) Tool to estimate climate benefits generated from a scenario in which farmers maintain existing practices and grow cover crops on an additional 15% of row crop acres and adopt no-till/strip till on 25% of acres currently managed with intensive or reduced tillage.

Integrating potential climate benefits into traditional conservation planning can help leverage additional financial resources and engage a broader audience in management discussions. AFT's Midwest Office partnered with over 30 organizations to establish a community of practice centered around building confidence in navigating these opportunities.

During this 90-minute symposium, we will: 1) unravel the state of the science surrounding climate benefits of soil health practices; 2) provide a tutorial overview of how to use the CaRPE tool to run scenarios to meet climate goals; and 3) share insights from our work engaging stakeholders across local, regional, and national scales. Collectively, these sessions will help inform future management of our soil and water resources by fostering consensus around the climate mitigation benefits of soil health practices.

From The Field to the Lab: Inside the Iowa Soybean Association's Water Monitoring Program

Track: 3, 2, 1 … ACTION!

Time: 1:00 PM – 1:45 PM CT

Moderator/Presenter: *Anthony Seeman, Iowa Soybean Association*

The Iowa Soybean Association (ISA) has a certified water lab that analyzes thousands of samples from rivers, streams, individual tile outlets, and edge of field practices from around the state of Iowa each year. Partnerships with local watershed projects, producers and importantly, the Agriculture Clean Water Alliance (ACWA), a non-profit association of ag retailers and support companies in the Des Moines and Raccoon River basins, among others, have allowed this expansive work to occur for over 20 years. This information is used to target areas for conservation planning and implementation projects. It's also provided to individual farmers to assess their operations. As Iowa farmers focus on strengthening and improving the opportunities for profitability from their fields, many are using water monitoring as an important management tool. ISA's water monitoring also helps evaluate the effectiveness of installed conservation practices on water quality. This session will take attendees from the field to the lab to experience the complete cycle from sample collection, analysis and result interpretation. See firsthand best management practices for taking samples and conducting other infield monitoring methods. Learn how samples are properly stored and analyzed with a tour of ISA's certified water lab. Lastly, discover how results are shared with producers and other stakeholders so that conservation and management decisions can be driven by science.

International Perspectives on Deforestation: The Solar Cooking Solution

Track: 3, 2, 1 … ACTION!

Time: 1:45 PM – 2:30 PM CT

Moderator: *Peg Barratt, Solar Cookers International*

Presenter: *Zainab Syed, Solar Cookers International*

Live demonstration of solar cooking Wood, charcoal and other biomass fuels are used by billions of cooks worldwide -- deforestation and desertification are the discouraging results.

Solar thermal cooking can save those forests, reduce climate change, and consequently reduce desertification of agricultural land. More than half of the deforestation in sub-Saharan Africa is attributable to trees cut for firewood and charcoal. More than half of the forests in Nigeria have been lost in the last 5 years. Kenya, for example, is only 6% forested. More solar cooking means fewer trees cut, and the retained forests can help reduce climate change. Wood that decomposes naturally, instead of being burned, enriches soil.

Currently there are more than 3 Million documented solar cooks, but this is few compared to the 3 Billion cooks using biomass fuels. Solar cooking captures free clean energy most days. Each solar cook, even using the sun only part time, saves a ton of wood annually. Solar cooking and solar pasteurization also protect health, save time and money.

If you concentrate sunlight, you can cook! We will demonstrate (a) a panel cooker – cooks like a crockpot, (b) a box cooker – cooks like an oven, and (c) a parabolic cooker – cooks like a gas burner. Inexpensive homemade, locally made around the globe, and commercial models are all effective solar thermal cookers at various price points.

Solar Cookers International is a not-for-profit resource: The Solar Cooking Wiki provides information worldwide. A demonstration project in the Kakuma Refugee Camp in Kenya has showed the feasibility of training new solar cooks. Advocacy efforts encourage national energy policies to include solar cooking. Research efforts include developing performance standards for solar cookers and establishing four global testing centers.

Solar cooking brings renewable energy to families and is a vital initiative in combating deforestation. Join us to see this in action!

Avoiding Conservation Tradeoffs in Controlling Phosphorus Loss from Agriculture

Track: Adaptive Management of Conservation Efforts

Time: 1:00 PM – 2:30 PM CT

Moderator: *Andrew Sharpley, University of Arkansas*

Conservation practices are intended to address a specific resource concern. For water and soil resources, conservation practices intended to improve one resource often affect the other resource, leading to unintended consequences. Minimizing these concerns requires a holistic consideration of trade-offs and systems of conservation practices that balance these trade-offs. Conservation practices are essential to reduce nutrients, in particular, and sediment in order to protect water quality. However, practices applied in different contexts cannot be expected to provide universal benefits and may even have antagonistic effects. This Symposium will describe the unintended consequences of conservation practices and offer innovative solutions to successfully mitigating phosphorus (P) runoff. For instance, no-till can increase soluble P runoff and vegetative buffers can transition from sinks to sources of P in runoff. These conservation trade-offs depend upon context, but may occur even when systems of conservation practices are implemented. Measures that can be taken to minimize or overcome tradeoffs will be discussed. Ultimately, acknowledgement of tradeoffs by the conservation community is necessary to improve outcomes.

Presentation 1: General introduction – *Lisa Duriancik, USDA NRCS*

Presentation 2: Introduction to conservation tradeoffs – *Andrew Sharpley, University of Arkansas*

Presentation 3: Tradeoffs Associated with Conservation Practices Avoiding the Loss of P – *Nathan Nelson, Kansas State University*

Presentation 4: Tradeoffs Associated with Conservation Practices Controlling the Loss of P - *Amy Shober, University of Delaware*

Presentation 5: Tradeoffs Associated with Conservation Practices Trapping the Loss of P – *Peter Kleinman, USDA ARS*

Integrating the NTT Water Quality Tool into the COMET-Farm Greenhouse Gas Assessment Tool for Co-Benefits Analysis

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM – 2:30 PM CT

Moderator: *Adam Chambers, USDA NRCS*

Since 2014 the COMET-Farm modeling platform has been available for public use in assessing the greenhouse gas balance of cropland, grassland, animal agriculture, agroforestry, and forestry practices. Funded by the USDA Natural Resource Conservation Service (NRCS), the USDA Climate Change Program Office (CCPO), and a variety of other state and private entities, COMET-Farm was first designed to assess how NRCS conservation practices affect the carbon and greenhouse gas balance of cropping systems. Nutrient Tracking Tool (NTT) was recently developed by a modeling team at Tarleton State University (TSU) to assess the water quality/quantity and crop production as affected by farm management practices. COMET-Farm team in collaboration with partners at TSU, the Soil Health Institute, the USDA, and CCPO, the at Colorado State University has incorporated additional ecosystem assessment capabilities that utilize the data entered into the COMET-Farm tool. These include greenhouse gas inventories, the effects of conservation practices on soil water holding capacity, and most recently water quality/quantity linked to runoff/leaching/erosion using NTT program. During this presentation members of the COMET-Farm and NTT teams will describe the COMET, NTT, and integrated COMET-NTT tolls and present examples of field-scale assessments of multiple ecosystem services, including greenhouse gas mitigation, water quality improvements, and cropping system resilience.

Presentation 1: Estimating carbon and water quality co-benefits of conservation practices – *Adam Chambers, USDA NRCS*

Presentation 2: Nutrient Tracking Tool: a tool for estimating water quality benefits of conservation practices – *Mindy Selman, USDA Office of the Chief Economist –Office of Energy and Environmental Policy; Ali Saleh, Tarleton State University*

Presentation 3: COMET-WQ: A combined tool for estimating carbon and water quality benefits of cropland – *Haley Nagle, Colorado State University; Crystal Toureene, Colorado State University*

Reaching a Broader Conservation Audience in the Time of COVID-19

Track: One World, Connected through Conservation

Time: 1:00 PM – 2:30 PM CT

Moderator: *Stephanie Mercier, Farm Journal Foundation*

Relevance - Two incessant natural resource issues are successfully addressed by this project: clearly communicating the benefits of conservation agriculture and helping newly interested producers to successfully adopt conservation systems.

General Methods - The symposium presents the results of an ongoing private – public partnership between Trust In Food (TIF) and NRCS established to address these issues by combining the Farm Journal's communication expertise and large farmer audience with NRCS's technical expertise and conservation delivery system. The agreement between NRCS and TIF was signed in February 2020. The agreement called for TIF to work in 5 pilot outreach areas to bring new producers to NRCS and to make the farmer experience with NRCS more successful and efficient. This was to be accomplished by TIF holding a conservation event for producers in each water quality outreach area that addressed the primary resource concern in the water quality outreach area, and by producing a series of 3 workbooks on conservation planning, soil health, and water quality. A related objective, to build peer to peer and farmer mentorships within the water quality outreach area, Conservation Stewards were to be enlisted in the outreach areas. The events were originally envisioned as face-to-face meetings demonstrating conservation systems appropriate for addressing natural resource issues of concern in the water quality outreach area; however, the COVID-19 pandemic erupted shortly after the project was launched and in person meetings became infeasible. The Symposium will present how the project adapted to the new state of the world, and identify organizing practices that were successful and those that required additional adjustment.

Preliminary Results – In examining progress after the first year of a two-year project, five zoom events have been conducted, recorded, and are available for viewing on the Internet, two workbooks completed, five blogs posted, and six Conservation Stewards enrolled in four outreach areas. Data on event participation and demographics and website hits were gathered. In addition, zoom participants were asked to respond to a survey. Statistics of engagement for the events, workbooks, and blogs have been collected and are being analyzed.

Contribution to Science and Society - The project has increased the interest in conservation in the five outreach areas, but also enabled us to identify several areas where remote (web-based) outreach can be more effective. These include closer coordination with Conservation Stewards, NRCS, and other partner organizations within the water quality outreach area, increased technical support on TIF website, and greater flexibility in event formats.

Presentation 1: Expectations and Preliminary Design for the NRCS: Trust In Food Conservation Outreach – *Daniel Dostie, USDA NRCS*

Presentation 2: Adapting Outreach Efforts in the Time of COVID-19 – *Skip Hyberg, H&H Conservation*

Presentation 3: Preliminary Results from the First Year of the NRCS Trust in Food Project – *Kinsie Rayburn, Trust In Food*

Enhancing Natural Hazard Resilience through Nonpoint Source Management

Track: Water Resource Assessment and Management

Time: 1:00 PM – 2:30 PM CT

Moderator: *Ellie Flaherty, US EPA*

Presenter: *Cyd Curtis, US EPA*

Polluted runoff is the dominant water quality problem facing the nation today. Nonpoint pollution (NPS) is diverse and includes agricultural runoff, acid mine drainage, unpermitted urban runoff, and more. Under Section 319 of the Clean Water Act (CWA), states, territories and tribes receive grants to implement their NPS programs. This work has restored over 10,500 miles of stream and over 250,000 acres of lakes since 2005. Examples of practices funded through the §319 program include floodplain and stream restoration/stabilization, wetland creation, reforestation, and agricultural conservation practices. In addition to improving water quality, these nature-based practices can create co-benefits by mitigating hazards including drought, flood, erosion, and harmful algal blooms.

This symposium will include an overview of EPA's §319 NPS Grants Program and a look at §319 success stories and NPS program highlights. Participants will learn about current factors influencing the Section 319 program administered by EPA, including: program updates, nonpoint source management plans, how agricultural and soil health practices can promote resilience to natural hazards, and watershed-based planning.

Using Woody Feedstock Biochar to Increase Climate Change Resilience

Track: Adapting Landscapes to Climate Change

Time: 3:00 PM – 4:30 PM CT

Moderator: *Carlos Rodriguez Franco, USDA Forest Service*

Discuss biochar markets development and how biochar can help to improve agricultural soils and develop carbon markets, with gains for forestry, agroforestry, and agriculture for restoring and increase soil and crop productivity. Biochar is an emerging commercial product with high potential for a wide variety of applications. We will also discuss how woody biochar could be beneficial on all federal lands by increasing resilience for better adaptation to climate change, increasing forest productivity, decreasing insect and disease attacks, and increasing other environmental benefits such as C sequestration, and water retention. In addition, to discuss how high-C biochars when used as a soil amendment, are a perfect tool for sequestering C within the mineral soil. If biomass is sustainably harvested, biochar supply chains can be C-negative. Furthermore, when net carbon balance in the forest ecosystem is positive, biochar can actively remove atmospheric CO2, with potentially major implications for mitigation of climate change.

Presentation 1: Current Status of biochar Markets – *Tom Miles, U.S. Biochar Initiative*

Presentation 2: Increasing Soil Health with Biochar – *Debbie Page-Dumroese. USDA Forest Service*

Presentation 3: Forest Management to increase biochar production – *Carlos Rodriguez Franco, USDA Forest Service*

Redesigning the Conservation Stewardship Program to Build Resilience and Mitigate Climate Disruption

Track: Conservation Economics and Policy

Time: 3:00 PM – 4:30 PM CT

Moderator: *Jeff Schahczenski, National Center for Appropriate Technology*

Presenters: *Doug and Ann Jones Crabtree, Vilicus Farms; Jeff Schahczenski, National Center for Appropriate Technology; Cristel Zoebisch, National Sustainable Agriculture Coalition; J.V. Worstell, Resilience Project*

Farmers and ranchers can substantially contribute to climate change adaptation and mitigation while improving system resilience by sequestering carbon and reducing greenhouse gas emissions at minimal cost. In January of 2021, President Biden released an executive order that, in part, directs the Secretary of Agriculture to garner input from farmers, ranchers and others "on how to use federal programs to support adoption of climate-smart agriculture practices." One federal conservation program was highlighted in President Biden's climate plan as the centerpiece to support farmer and rancher climate change adaptation and mitigation efforts – the Conservation Stewardship Program (CSP). With over eight percent of agricultural land enrolled in the CSP, it is the largest working lands conservation program in the U.S. and has great potential to expand climate-friendly systems and practices. In this symposium, we explore how CSP can be redesigned, reformed, and revamped to meet this challenge. The panel will include four presenters covering the following topics:

- An overview of CSP, including analysis of latest enrollments, discussion on the operations that have typically benefited in the past.
- A review of legislative and administrative actions that can make the CSP more climate directed will be shared.
- How CSP enables ecologically resilient agriculture production systems built on adaptability, diversity and soil and plant infrastructure.
- Promises, limitations, challenges in modifying the Conservation Assessment Ranking Tool (CART) to improve CSP to address climate disruption.
- Farmer's view of climate-smart agricultural practices. What practices really work to build soil organic matter, make farming systems more resilient to climate variability and- most importantly- eliminate dependence on nitrogen fertilizers and pesticides that are responsible for the vast majority of agriculture's greenhouse gas footprint.

The Civic Scientist

Track: Justice, Equity, Diversity, and Inclusion

Time: 3:00 PM – 4:30 PM CT

Moderator: *Erin Meier, Green Lands Blue Waters*

Presenters*: Katie Black, University of Minnesota; Maria Hetman, University of Missouri; Sienna Nesser, University of Minnesota; Huong Nguyen, Iowa State University; Kyle Sherbine, University of Minnesota*

Last year, months into a global pandemic and weeks after global civil rights protests rocked their cities, a diverse group of 18 graduate students in ag-related programs across the Midwest were tasked with reflecting on their experiences as young scientists in the midst of unprecedented societal change. They were asked by Green Lands Blue Waters to share where they find hope and what they envision for the future. GLBW has been sharing their essays with its network via newsletters and social media as "The Civic Scientist" series- https://greenlandsbluewaters.org/civic-scientists-series/.

While the scope of the Civic Scientists' statements vary, several common themes emerged from this collection of writings. These include emphases on:

- Justice and equity- "I have understood the past six months, in some ways the past 400 years in this way: The world was cracked. We all lived year after year, stepping over or avoiding many deep fissures."
- Challenging the status quo- "In my dream world, I would like to see more diversity and perenniality across all landscapes, such as prairies replacing lawns ... more home and community gardens."
- Optimism in changing times- "I encourage everyone...to take a look at what Black farmers and activists around the country are doing. They have been providing me sparks of hope when I question the efficacy of my work."
- Understanding that scientific research does not exist in a vacuum- "Solving problems is more than just applying knowledge to find a solution, but understanding the implications different results may have."

In this session, several Civic Scientists will offer their reflections on this experience as next-generation agricultural professionals a year after the events that inspired their writing. They will engage participants in an active discussion informed by how equity, diversity, and justice tie into their own research projects, their perspectives on building a diverse research workforce, and what it means to be a "civic scientist."

Visionary Conservation: Science and Practice

Track: One World, Connected through Conservation

Time: 3:00 PM – 4:30 PM CT

Moderator: *Francisco J. Arriaga, University of Wisconsin-Madison*

Soil and water conservation efforts in North America were put into drive after the Dust Bowl in the 1930's, however, after these many decades we continue to find new challenges and solutions. Scientific and technological advances have been important, as well as putting practices on the ground and policy. This symposium will cover recent cutting edge efforts in soil and water conservation, targeting scientist and practitioners. Research and implementation of these efforts will be discussed during this symposium. This symposium will also be presented during the 2021 Soil Science Society of America International Meeting and sponsored by the Soil and Water Conservation and Management Division.

Presentation 1: Historical technological Advances in Soil and Water Conservation from the 1930s to the Present – *Jorge Delgado, USDA ARS*

In 1935, during the midst of the Dust Bowl era, the U.S. Congress enacted legislation leading to the establishment of a new agency, the USDA Soil Conservation Service. Renamed nearly 60 years later (in 1994) as the Natural Resources Conservation Service (NRCS), this agency, in cooperation with the USDA Agricultural Research Service (ARS), university partners, farmers, consultants, and many others, has contributed to improved sustainability. Delgado (2020) reported that "the reduction of erosion rates during the golden era of soil and water conservation (1930s to 1980s) is one of the great conservation success stories of the 20th century, yet it often goes untold." Extrapolating from erosion data reported in NRCS (2010) and Argabright et al. (1995), Delgado (2020) estimated erosion rates of 2.9 mm yr^{-1} (0.11 in yr^{-1}), 0.77 mm yr^{-1} (0.03 in yr^{-1}), 0.67 mm yr^{-1} (0.03 in yr^{-1}), 0.51 mm yr^{-1} (0.02 in yr^{-1}), and 0.51 mm yr^{-1} (0.02 in yr^{-1}) in 1930, 1982, 1992, 2007, and 2020, respectively. Technological advances in modeling, remote sensing, geographic information systems (GIS), and other areas have contributed to significant advances in precision farming and precision conservation during the last three decades. Now climate change is creating new challenges for soil and water conservation. This seminar will cover some of the scientific advances and challenges in conservation since the 1930s as well as touch on emerging challenges and opportunities that may lie ahead for soil and water conservation in the decades to come.

Presentation 2: Regional Modeling of Soil Erosion and Water Runoff: Daily Erosion Project – *Richard Cruse, Iowa State University*

Soil erosion continues to plague land surfaces dedicated to food, feed, fiber, and fuel production. An estimated 1/3 of the farmed area in the US Corn Belt is devoid of A-horizon material because of water and tillage induced soil erosion. Identifying temporal and spatial soil

erosion rates is critical to selecting and implementing best practices to reduce or eliminate soil loss. The Daily Erosion Project (DEP) utilizes the process-based Water Erosion Prediction Project (WEPP) model to generate near real-time sheet and rill erosion estimates across all or sections of multiple Midwestern states at a daily time step. DEP uses NEXRAD estimated precipitation with 1 km X 1 km spatial and 2-minute temporal resolution along with field level crop rotation and management information from the Agricultural Conservation Planning Framework, https://acpf4watersheds.org, the gridded SSURGO, and LiDAR-derived 2-m Digital Elevation Models for WEPP inputs. Hillslope sheet and rill erosion, soil detachment, and water runoff is scaled to the Hydrologic Unit Code 12 (HUC12) watershed level and presented as the daily average for each of these parameters via a web interface. The DEP system framework is structured with data input layers allowing a wide range of scenario evaluations. DEP has been used to determine the soil erosion impacts of perennial biomass production on targeted slope gradients for different major land resource areas; to determine the change in statewide average soil erosion rate by converting existing tillage managements to no-till; to compare soil erosion of existing corn-soybean systems to a diverse four crop rotation; and to determine the impact of early vs. delayed row-crop planting on soil erosion rates. Spatial expanse of DEP continues to increase with several more states recently added to the ACPF framework, making DEP coverage a realistic goal across most of the Central US.

Presentation 3: Well-Managed Grazed Perennial Grasslands for Profitable Farming, Soil Accumulation, Clean Water, and Biodiversity – *Randy Jackson, University of Wisconsin-Madison*

Agriculture in the North Central US mainly occurs on grassland soils whose energy and matter are being mined by annual grain crops. Meantime, these cropping systems typically are not particularly profitable for farmers and society continues to look to farmers to provide ecosystem services beyond feed, food, fiber, and fuel. Restoring the ecosystem function to agricultural landscapes is critical to achieving clean water, building soils, and supporting biodiversity. Well-managed grazing of perennial grasslands for milk and meat production can do this while providing a profitable enterprise. We must develop policies and markets that simultaneously push and pull livestock production on perennial grasslands as our dominant agricultural system.

Presentation 4: Use of Vulnerability Assessment to Support Conservation Planning for Soil and Water Resources: The CEAP Soil Vulnerability Index – *Lisa Duriancik, USDA NRCS*

The Conservation Effects Assessment Project (CEAP) team created a set of soil vulnerability rules to develop an index. This index, the Soil Vulnerability Index (SVI), can be used to rank soil into classes with inherent vulnerabilities. Combined with CEAP data, this information can be used for conservation planning. This presentation will discuss this multi-disciplinary team effort.

Presentation 5: Identifying Opportunities for Conservation Practice Placement to Enhance Soil Health and Water Quality: The Agricultural Conservation Planning Framework (ACPF) – *Emily Zimmerman, Iowa State University*

Agricultural landscapes in the US are often highly productive, but frequently produce negative environmental externalities that lead to reduced environmental benefits at local and regional scales. The Agricultural Conservation Planning Framework (ACPF) is a science-based, data-driven decision support tool that assists conservation planners and stakeholders with identifying opportunities to strategically place conservation practices within fields, at fields' edges, and in riparian areas to reduce nutrient and sediment loss in agricultural landscapes. The ACPF applies watershed planning concepts using publicly available geospatial datasets and an ArcGIS toolbox to strategically locate opportunities for conservation practices at the field scale and watershed scale (HUC-12). Presently, the ACPF datasets are available in 10 states in the Mississippi River Basin and availability continues to expand. ACPF tools allow conservation planners to identify fields in a watershed that may be most likely to contribute nutrients and sediment to surface water, and strategically locate within field, edge-of-field, and riparian conservation practices. The ACPF currently places eight conservation practices by evaluating site-specific criteria and suitability. One of the strengths of the ACPF is its ability to synthesize complex data into accessible and easy-to-interpret outputs that provide suites of conservation options – and function as a tool to begin a conversation about conservation opportunities. Outputs from the ACPF can assist conservation planners and stakeholders in visualizing the link between nutrient and sediment loss risk and opportunities to address those resource concerns. Active areas of research and model development include geographic expansion, estimations of nutrient reduction outcomes, financial costs (direct and opportunity), valuation of environmental benefits, and integration with federal conservation programs.

ORAL PRESENTATIONS

Tuesday, July 27

Oral Presentation Descriptions

An Ecohydrological Assessment of Potential Impacts of Climate Change on Herpetofauna in the Connecticut River Watershed

Track: Adapting Landscapes to Climate Change

Time: 11:00 AM – 12:30 PM CT

Authors: *Cayla Paulding (Umass Amherst)**

Climate change is bringing challenges to wildlife worldwide. Effects of climate change such as changing precipitation and temperature patterns, as well as increased frequency and severity of storms are already being seen and are forecasted to magnify. This change in hydrology is altering earth's ecosystems. The resident biota must either adapt to these changes, shift ranges, or face extinction. Herpetofauna are particularly vulnerable to these changes based on their physiology and natural history. Since reptiles and amphibians are vital components to ecosystems at large, it is necessary to determine if and how they may be affected. This study examines the Connecticut River watershed at a hydrologic unit code (HUC) 10 watershed-scale. The Hydrologic and Water Quality System (HAWQS) model produced three scenarios for the watershed: baseline or default, climate change relating to a representative concentration pathway (RCP) 4.5, and climate change RCP 8.5. These scenarios will shed light on the watershed's current hydrologic regime and how it may change with climate change based on medium (RCP 4.5) or severe (RCP 8.5) levels of greenhouse gases being emitted. This assessment may determine what, if any, measures need to be taken in order to protect herpetofauna of the Connecticut River watershed.

**Denotes primary author*

Climate Indicators and Adaptation Strategies in the Long-Term Agroecosystem Research Network

Track: Adapting Landscapes to Climate Change

Time: 11:00 AM – 12:30 PM CT

Authors: *Lindsey Yasarer (United States Department of Agriculture - Agricultural Research Service)*; Emile Elias (USDA-ARS); Glenn Moglen (USDA-ARS); Dennis Todey (USDA-ARS); Claire Baffaut (USDA–ARS); Phil Heilman (USDA-ARS); Eric Russell (Washington State University); Dave Goodrich (USDA-ARS); David Hoover (USDA-ARS); Sarah Goslee (USDA-ARS); John Zhang (USDA-ARS); Stephen Hamilton (Michigan State University)*

The USDA Long-Term Agroecosystem Research (LTAR) Network consists of 18 research sites in the continental US, representing rangelands, croplands, and integrated agricultural systems. The 18 sites are situated across a wide range of climate and agricultural systems, from the Jornada and Walnut Gulch sites in the arid southwest, to the Archbold site in tropical Florida, and up to the Northern Plains site in North Dakota. The LTAR network is driven by research questions that address sustainable intensification of agriculture using observational methods to measure the effects of climate on agronomic and environmental outcomes, while also assessing climate adaptation strategies through experimental approaches. A synthesis of research on climate impacts and potential adaptation strategies has been developed for each LTAR site. This presentation will share results from these syntheses, including regional similarities and differences. For example, one climate indicator present at most sites relates to extremes in moisture, both droughts and flooding, that are becoming more common and are projected to intensify with climate change. However, adaptations to these extremes may differ across the network depending on agricultural commodities produced, environmental resources, dominant soil types, and seasonal climate patterns. Examples of regional adaptation strategies to moisture extremes will be discussed and compared, as well as avenues for future research to address climate adaption within the LTAR network. This work also will draw on the USDA "Climate Indicators for Agriculture" report to evaluate climate indicators across the 18 LTAR sites.

**Denotes primary author*

Legacy Sediment 2.0: Enhanced Mapping and Decision Support Tool

Track: Adapting Landscapes to Climate Change

Time: 11:00 AM – 12:30 PM CT

Authors: *Joseph V. Sweeney (Water Science Institute)*; Sam Feibel (Water Science Institute)*

Legacy Sediment (LS) is recognized as a significant environmental impairment largely caused by a combination of historic land use practices and the construction of mill dams. The result was often inundated valley bottoms and buried wetland complexes creating a "Pompeii Effect" that altered natural hydrologic functions. While LS is ubiquitous throughout the mid Atlantic region it is particularly acute in 1-3 order streams that comprise 85% of the waterways in the Chesapeake Bay region. The Water Science Institute has catalogued over 1500 such sites in 6 counties that comprise this presentation. The reservoirs at these sites quickly filled with sediment eventually forming terraces that can extend several km above the dams. In time many dams have breached through active removal or neglect exposing the terrace banks to incision and erosion. These breaches contribute significant TSS, N and P loads to local watersheds posing a significant conservation management challenge. Our tool uses high resolution LIDAR (Light Detection and Ranging) point cloud data to create digital elevation models (DEMs), map LS terraces, extract longitudinal profiles of the water surface along streams and generate profiles of terraces tops. Custom algorithms generate enhanced stream centerlines to further define terrace areas. These data sets can be combined to calculate areal extent and thickness of the valley bottom sediment deposits. Combined with bulk density field and laboratory analysis these calculations can convert terrace mass into tons or cubic meters of TSS and pounds of N and P. Using the time difference between the generation of LIDAR data sets permits users to determine the rate of erosion for a specific polygon, stream length or watershed. This mapping is enhanced by the addition of canopy layers and parcel data to identify specific erosion "Hotspot" sites. Using stream erosion data can further inform what combination of BMP's best suit specific sites.

**Denotes primary author*

Recycling Drainage Water for Increased Resilience and Improved Water Quality

Track: Adapting Landscapes to Climate Change

Time: 11:00 AM – 12:30 PM CT

Authors: *Chris Hay (Iowa Soybean Association)*; Samuel Phillips (Iowa State University); Matthew Helmers (Iowa State University); Sotirios Archontoulis (Iowa State University)*

Farmers in the Midwest face water management challenges from increasing frequency and duration of both too wet and too dry periods--often within the same year. Drainage water recycling (DWR) is an emerging practice where subsurface and surface drainage water is captured and stored for reuse as supplemental irrigation during dry periods. DWR has great potential to increase resiliency to both excess and deficit water conditions and also to reduce nutrient loading from drained cropland by capturing and reusing drainage water that would otherwise be discharged downstream. The Agricultural Production Systems sIMulator (APSIM) was used to model 40 years of corn production in Central Iowa with and without DWR based on 6 years of field data from a DWR site near Story City, Iowa. Simulations were run under scenarios with varying levels of water availability and with historic weather data and climate change scenarios (increased spring precipitation and reduced summer precipitation). DWR produced average yield benefits between 19 and 22 bushels per acre under historic weather conditions, and yield benefits increased to 23 to 28 bushels per acre under climate change conditions. Economic returns varied greatly depending on the scenario. Two new DWR field research sites being constructed in Iowa will also be briefly discussed. DWR has the potential to transform crop production on drained lands, creating cropping systems that are more resilient to climate risks and promoting long-term sustainability.

**Denotes primary author*

Combining Research with Community Wisdom to Help Secure a Vibrant and Healthy Future for People and Wildlife

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Authors: *Meredith Hickman (Smithsonian Conservation Biology Institute)*; Iara Lacher (Smithsonian Conservation Biology Institute)*

The Changing Landscapes Initiative (CLI) is a Smithsonian-led program bridging the gap between scientists and communities. CLI scientists work alongside community members to evaluate the regional impacts of land use change on wildlife, ecosystem services, and community health. Its mission is to combine research with community wisdom to help secure a vibrant and healthy future for both people and wildlife. CLI engages with communities, planners, conservation groups, and other scientists to collectively develop resilient, long-term plans that preserve the natural, cultural, historic, and economic resources that make a place unique.

During this webinar, CLI will present their approach to community-driven conservation science through scenario planning and land use modeling. Presenters will highlight results from recent analyses conducted to unveil the potential impacts of land use change on ecosystem services vital to the health of people and wildlife - from water quality to forest connectivity. CLI will also discuss their best practices for engaging communities, and effectively spanning the science-policy gap, with an emphasis on communications tools like storytelling and graphic visualizations.

**Denotes primary author*

Do Cultural Ecosystem Services Matter in Wetland Protection? A Delphi Survey Approach

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Authors: *William Kleindl (Montana State University)*; Sarah Church (Montana State University); Ashlie Gilbert (Montana State University)*

Wetlands, streams, and floodplains (aquatic systems) are an important resource for social and ecological wellbeing. Since the early 1990s, Federal policy has required a no overall net loss (NNL) of wetland area (i.e. aquatic systems), functions, and values in the United States (US). Past efforts to build assessment tools have focused primarily on wetland structure and function, and less on inherent services provided by aquatic ecosystems that are valued by people (hereafter referred to as ecosystem services [ES]). Moreover, there has been little effort to develop assessment tools that measure wetland services in a rapid and repeatable manner. Through this research, we seek to develop a framework and generalized methodology for the rapid assessment of ES provided by wetlands, streams and their riparian buffers for use in permitting, compensatory mitigation, and preservation decisions. In this talk, we will present our process and results on a consensus process to build a list of ES through an online Delphi survey in two rounds, administered to aquatic systems experts in several western states (n=179). First, we will present the round one list of important cultural, provisioning, and regulating ES, followed by the consensus list of ES that resulted from ranking in the round two survey. We will then relate these results with the analysis of a question asking respondents to determine where to mitigate the loss of a wetland that provides bird habitat and bird watching services to a fictional community. Finally, we will discuss the implications of these results for land-management and compensatory mitigation decisions, as well as the next steps in tool development. We predict our results will show that current assessment tools do not account for the human benefits that aquatic systems experts deem to be important. Ultimately, these results will contribute to a rapid wetlands assessment tool that will be useful to compensatory mitigation decision making in the Western US.

**Denotes primary author*

LiDAR Based Hydro-Conditioned Hydrological Modeling for Conservation Practice Placement in Agroecosystems

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Authors: *R. Srinivas (Birla Institute of Technology and Science, Pilani)*; Matt Drewitz (BWSR); Joe Magner (University of Minnesota)*

High resolution Light Detection and Ranging (LiDAR)-derived Digital Elevation Models (DEMs) improve hydrological modeling and identification of the best conservation practices at targeted locations to restore agroecosystem. Targeted locations of practices (i.e. bioreactors, grass waterways, riparian buffers etc.) are determined based on physiographic and terrain criteria as well as hydrologic characteristics. However, the inability of LiDAR data to represent the conveyance of water under or through the surfaces (i.e. bridges or culverts) impedes the simulated flow, resulting in false upstream pooling. Improper simulation of flow affects the accuracy of pollutant load estimations and targeted locations delineated by watershed models or models built upon hydro-conditioned DEMs (hDEM). Hydro-conditioning is required to accurately replicate the landscape hydrologic connectivity. This study explores the variations in the criteria determining the targeted practice locations using Agricultural Conservation Planning Framework (ACPF), based on manual and automated hDEMs for the Plum Creek watershed, Minnesota. Manual 'hDEM' retains true depressions, and places breach lines creating an open channel for water movement. Automated 'hDEM' does the same using a python based mathematical code in ArcGIS. Locations, size and shape of bioreactors, drainage management, farm ponds, nutrient removal wetlands, riparian buffers are severely affected by hydro-conditioning. Results indicate that manual 'hDEM' is best suited for field scale planning and practice siting, and automated 'hDEM' is appropriate for uses such as 'Daily Erosion Project' work at the sub-watershed scale. Based on this study, we recommend that watershed managers invest financial and technical resources in developing high level hDEMs for precise modeling to enhance ecological restoration. Consequently, decision makers can communicate sound information to landowners and watershed stakeholders.

**Denotes primary author*

Creating a Regionally Appropriate and Representative Soil Health Workbook: Best Practices and Examples

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Linden M. Schneider (Quivira Coalition)**

Agencies, extension, and land managers provide an abundance of soil health resources, but recent listening session results suggested that producers both feel that they don't have enough information to make management decisions, and that they are overwhelmed by how much information is available. Agencies produce their own materials that may be connected to available funding, but with so many resources available, as a producer, which one should you turn to? Further, working in drylands requires specific metrics - striving to reach mollisol levels of organic matter in the Chihuahuan Desert grasslands would be fruitless!

To address these outstanding issues, the Quivira Coalition, agencies, extension, and land managers, created a Soil Health Workbook for dryland crop and rangelands. The workbook supports the New Mexico Healthy Soil Act (2019) and the establishment of a soil health network of technical service providers and producers in the state.

We will discuss our best practices for coordinating the multi-stakeholder development of a regionally appropriate workbook such that the outcome is a usable document for everyone. We will provide a brief tour of the workbook and talk through how we brought whole systems thinking into the spatial (from clay particles to acres) and temporal (from seconds to centuries) scales that interact to form and transform soil ecosystems. We will take a look at the well known the physical, chemical, and biological characteristics of soils from a unique perspective that considers drylands and the New Mexico Healthy Soil Act. The workbook is designed to inspire practice change, and we provide not only ideas on how to change but importantly how to monitor and evaluate the effect of these changes. Finally because the workbook is a resource for technical service providers, we offer up an addendum on teaching methods drawing from the principles of active learning.

**Denotes primary author*

Farm Connect Tool

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Stephen P. Bontekoe (Limestone Valley RC&D)**

A community driven and developed outreach tool was created using technology engage with under reached land owners. The Tool is currently being deployed to the field and adjusted with feedback. This tool provides users information on conservation technical assistance and funding opportunities that are specific to their properties exact location. The conservation partner side of the tool provides for diverse partner engagement and a de-siloing of conservation resources. Examples of conservation options could be as diverse as the partners serving a given geography, as the options are driven by the community input data. This "clearinghouse" for conservation resources allows for everyone from the biggest government programs to the smallest nonprofit program to be represented in one place on equal footing. This platform puts conservation decisions in the hands of land managers and connects the right projects with the right resources.

**Denotes primary author*

Understanding Differences in the Attendance of Adopters and Nonadopters of Agricultural Conservation Practices at Outreach Events

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Daniel Read (University of Maryland); Anil K Kumar Chaudhary (The Pennsylvania State University)*; Lisa Wainger (University of Maryland); Alexandra Carroll (University of Maryland)*

Agricultural nonpoint source pollution remains a major contributor to water quality impairments in the Chesapeake Bay watershed. Education and outreach events are one way to encourage members of the agricultural community to adopt voluntary soil and water conservation practices. However, little research has explored whether attendees at such events are already predisposed to engaging in conservation behaviors. This potential for sampling bias confounds estimates of how effective outreach events are at encouraging conservation and suggests that more research is needed on what motivates people to attend such events. In this presentation, we present results of a phone survey of 101 Maryland farmers describing how they respond to advertisements for outreach events and what kind of events they attend. In doing so, we highlight differences in farmers' responses depending on whether they have adopted one of several relevant soil and water conservation practices. We collected data between September-November 2020 and analyzed data using qualitative comparative analysis (QCA). Our findings suggest that, compared to adopters, non-adopters are much more selective in what advertisements they decide to read, and that they decide whether to attend events largely on the practicality of attending, both in terms of logistics and whether they think the information they learn at the event will offset time taken away from the farm. Future research can build on these findings by experimentally testing the simplicity of messages in outreach event advertisements, as well as the time and location of such events and whether they are virtual. Based on our findings, we provide practical recommendations for conservation professionals to advertise their outreach events in a way that is more likely to motivate non-adopting farmers to attend.

**Denotes primary author*

Whole Farm Conservation Best Practices Manual

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Matthew Helmers (Iowa State University)**

Across the Midwest there are efforts to increase the adoption of a range of conservation practices. Landowners and farmers need information about what practices may work for them and how to implement these practices or who to contact for assistance. In existing educational programming efforts we have frequently gotten questions related to these needs which led to the developed of the Whole Farm Conservation Best Practices Manual. This is being integrated in a range of educational efforts from webinars, virtual field days, one-on-one educational events, and boot camp type activities where individuals are going in depth on discussion of the practices. This manual and other activities are educating farmers and landowners about conservation practices and providing easy to follow decision tools they can use to get started with practices or help determine what practices might be best suited for their land. The manual includes information on how to get started using no-tillage, cover crops, and diverse rotations. The manual also includes information on doing preliminary evaluation of edge-of-field practices such as bioreactors, saturated buffers, wetlands, and prairie strips. The manual includes decision trees for these practices to help farmers and landowners get started and where they might find additional resources.

**Denotes primary author*

Examining Sources and Pathways of Phosphorus Transfer in a Ditch-Drained Field

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: *Anthony Buda (USDA-ARS)*; Lauren Mosesso (University of Delaware); Amy Collick (University of Maryland Eastern Shore); Casey Kennedy (USDA-ARS); Gordon Folmar (USDA-ARS); Amy Shober (University of Delaware)*

Understanding the processes that mobilize and transport dissolved phosphorus (P) during storms is critical to managing P in agricultural landscapes with legacy soil P and ditch-drainage. In this presentation, we characterize composite and event-based concentration-discharge (C-Q) relationships to elucidate the mechanisms driving dissolved P loss at a ditch-drained site on Maryland's Lower Eastern Shore. Briefly, we monitored discharge in an open field ditch and collected samples of drainage water (baseflow and stormflow), soil water, and groundwater for dissolved P determination over a 14-month period from 2017-18. Analyses of composite (i.e., long-term) C-Q patterns for dissolved P revealed that C-Q slopes differed significantly above and below a discharge threshold of 6.4 L s^{-1}, which was roughly equivalent to median discharge in the drainage ditch over the study period. For discharges below the threshold, we observed a slightly diluting C-Q pattern for dissolved P. For discharges above the threshold, we noted an increasing C-Q pattern for dissolved P. Consistent with the composite C-Q relationships, event-based sampling also revealed that C-Q patterns for dissolved P differed during small and large storms. During small storms, C-Q patterns for dissolved P suggested dilution, with deeper groundwater with low dissolved P concentrations (< 0.05 mg L^{-1}) serving to dilute initially high dissolved P concentrations (0.40 mg L^{-1}) prior to the storm. In contrast, large storms with flows well above the discharge threshold produced C-Q patterns indicative of dissolved P flushing. For these storms, heavy rainfall likely induced rising water tables and vertical preferential flows that tapped dissolved P-enriched shallow soil waters (0.90 mg L^{-1}) and transferred these P sources to ditch drainage waters. Findings from the study highlight the need to mitigate vertical P stratification as a means for reducing dissolved P flushing from ditch-drained soils with legacy P.

**Denotes primary author*

FloodWise: Using Natural Resources Infrastructure for Flood Reduction for Farms and Communities in Eastern North Carolina

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: *Meredith Hovis (North Carolina State University)*; Frederick Cubbage (North Carolina State University); Chris Hollinger (North Carolina State University); Theodore Shear (North Carolina State University); Barbara Doll (North Carolina State University); Jack Kurki-Fox (North Carolina State University); Daniel Line (North Carolina State University); Jane Harrison (North Carolina State University); Andrew Fox (North Carolina State University); Madalyn Baldwin (North Carolina State University); Travis Klondike (North Carolina State University); Michelle Lovejoy (North Carolina Foundation for Soil and Water Conservation); Thomas Potter (North Carolina Foundation for Soil and Water Conservation); Keith Larick (North Carolina Farm Bureau Federation); Bryan Evans (North Carolina Association of Soil and Water Conservation District)*

We have developed a new line of research and development that examines the merits of natural infrastructure practices for flood reduction for farms and communities in Eastern North Carolina. We have termed this line of research "FloodWise" to describe the water quality, flood mitigation, farm benefits, and community governance connections. This overview summarizes the primary components of this research that we have been performing.

This project will focus on identifying selected water quantity storage practices that could reduce flooding on individual farms and downstream communities. Natural infrastructure stores water on farm and forest lands to prevent rapid flooding, which then release it naturally or through engineered structures afterwards. Participating farmers would receive government conservation and water farming payments for storing that water, in order to avoid flooding of valuable crops and structures on farms and help reduce floods downstream. This presentation will summarize the status of and early findings from this project.

**Denotes primary author*

Quantification of Surface Hydrologic Processes Influencing Nutrient Transport on Upland Areas

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

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

Runoff is one of the principal variables examined in hydrology and flow rate is used to quantify runoff. Water quality is an important topic in the science of hydrology. Identification and quantification of the effects of varying runoff rate on water quality characteristics would allow better water quality management. The goal of this investigation was to use existing experimental data to develop and test nutrient load-runoff rate relationships representative of upland areas. Dr. Gilley has been conducting field rainfall simulation studies since 1997 to identify sustainable cropping, management, and conservation practices on land application areas. After completing the initial series of rainfall simulation tests using widely adopted rainfall simulation protocols, inflow was added to the test plots in successive increments to simulate greater slope lengths. Overland flow rates up to 25 times the value without the addition of inflow were introduced resulting in equivalent slope lengths as large as 100 m. The extensive field tests indicated that two mechanisms govern nutrient transport on upland areas: the maximum capacity of manure to release nutrients and the ability of overland flow to transport nutrients that are released. Experimental results indicated that the point of inflection between these two transport mechanisms in many cases occurred at downslope distances of approximately 10 – 12 m. Once a particular flow rate (downslope distance) has been reached, nutrient transport rates do not change. Nutrient loads were found to vary in a liner fashion with flow rate at small runoff rates. Since a single data point can be used to identify the slope of a linear equation, it may be possible to extrapolate nutrient transport data collected from small plots to much longer slope lengths. The existing experimental data base found in the literature could then be used to identify optimal land application and manure management conditions on a field scale.

**Denotes primary author*

Mapping On-Farm Irrigation Systems in Southern Idaho

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: *Sayjro K. Nouwakpo (USDA-ARS)*; David Bjorneberg (USDA ARS)*

About half (or $106.3 billion in 2012) of the market value of crops sold in the United States is produced on irrigated farms with the vast majority (71%) of these farms located in the 17 western states. Irrigation water whether sourced from surface or subsurface water resources is applied to these agricultural fields using a variety of systems categorized in three broad groups: gravity irrigation, microirrigation and sprinkler irrigation. In the 82,000 ha Upper Snake Rock watershed located along the south side of the Snake River in south central Idaho, two major types of irrigation systems are used: sprinkler and furrow irrigation. Concerns over high rates of sediment and nutrient loads to the Snake River with the historically used furrow irrigation system led to increased adoption of various forms of sprinkler irrigation systems. For an accurate assessment of the impact of changes in irrigation systems on soil and water resources in the watershed over time, data on the spatial extent and distribution of the various types and forms of irrigation systems are needed. Such spatial data currently do not exist and are difficult to assume considering the highly dynamic adoption rate of new irrigation systems in the watershed. This study aims to apply advances in pattern recognition and machine learning to publicly available remote sensing datasets to identify and survey irrigation systems in agricultural fields across the watershed. With this new methodology, past and future changes in irrigation systems can be related to water quality dynamics from available irrigation return flow monitoring sites across the watershed. This technique could also be used in other watersheds where irrigation systems are changing.

**Denotes primary author*

Cover Crop Effects on Soil Moisture Dynamics of a Corn Cropping System

Track: Adaptive Management of Conservation Efforts

Time: 1:00 PM - 2:30 PM CT

Authors: *Sidath S. Mendis (School of Natural Resources, University of Missouri, Columbia)*; Ranjith Udawatta (University of Missouri); Stephen Anderson (University of Missouri); Ronald Cordsiemon (Elsberry Plant Materials Center (MOPMC))*

Soil moisture plays a major role in crop production, where water infiltration and drainage of the soil governs the volumetric soil moisture content (θ). With the climate change, the variability of rainfall patterns has increased with time, which can increase the occurrence of environmental extremities such as severe droughts as well as flood conditions in the future. This can create serious problems to the future food security. Integrating cover crops (CC) with cropping systems can help mitigate these extreme conditions. The objective of this study was to evaluate the CC effects on the θ of a corn (*Zea mays* L.) cropping system. The study was conducted at the Elsberry Plant Material Center - USDA, Missouri, USA. The treatments were, 1) no till cover crop (NC), 2) conventional till no cover crop (CN), and 3) no till no cover crop (NN). A three species CC mixture including Cereal Rye (*Secale cereale* L.), Crimson Clover (*Trifolium incarnatum* L.), and Daikon Radish (*Raphanus sativus* L. var. *Longipinnatus*) was established in the NC treatment in 2019 (first CC establishment). Spectrum Technologies Water Scout SM100 soil moisture sensors were used at 5-, 10-, 20- and 40- cm soil depths to monitor changes in θ in 15 min intervals. In each treatment plot, data was collected from four locations. Data downloading from dataloggers were done using a laptop computer. Soil bulk density (BD) and gravimetric moisture contents (w) were estimated for each plot at four depths through soil sampling near the sensors. The w values were converted into θ using the calculated BD. These calculated θ values were used to develop a regression relationship to calibrate the soil moisture sensor θ readings. Long term use of CC can improve soil organic matter content, reduce soil bulk density, and reduce evaporation losses through mulch accumulation. Therefore, CC might become a viable solution in soil moisture conservation.

**Denotes primary author*

Effect of Alfalfa (*Medicago sativa* L.) on Edge-of-Field Nitrogen (N) and Phosphorus (P) Loss in Ohio

Track: Adaptive Management of Conservation Efforts

Time: 1:00 PM - 2:30 PM CT

Authors: *Lourdes D. Arrueta Antequera (The Ohio State University)*; Kevin King (USDA-ARS); Brittany Hanrahan (USDA-ARS); Margaret M. Kalcic (Ohio State University)*

Row crop agriculture is a major contributor of nitrogen (N) and phosphorus (P) to water bodies in the United States, having significant environmental and economic consequences. Perennial crops are generally expected to have reduced nutrient losses compared to traditional row crops because of their longer growing season and minimal nutrient requirements. However, the impacts of perennial crops are likely to vary by species and geographic location; consequently, comprehensive data on the changes in nutrient runoff when perennial crops are introduced into typical row crop agricultural rotations are needed. Thus, the objective of this study was to quantify the influence of perennial crops, specifically alfalfa (*Medicago sativa* L.) on nitrate (NO_3^--N), total N, dissolved reactive P (DRP), and total P from subsurface drainage and surface runoff. We examined the effect of alfalfa using a Before-After-Control-Impact (BACI) experimental design with one control site (i.e., no alfalfa) and one impact or treatment site (i.e., with alfalfa) on two different farms located in the northwest quadrant of Ohio. One pair of sites had a conventionally managed corn-wheat rotation for four years prior to the planting of alfalfa on the impact site, while the second pair was historically managed in a corn-soybean rotation. Impact sites with alfalfa had lesser NO_3^--N, TN, and TP loads compared to the control sites without alfalfa, demonstrating that perennial crops generally reduced both N and P loss. However, DRP loads were not statistically different in the alfalfa treatment compared to typical rotations. Our findings suggest that introducing alfalfa into intensive row crop rotations could improve water quality in adjacent and downstream water bodies by reducing N and TP losses. More work on the effects of alfalfa on DRP losses are still needed.

**Denotes primary author*

Overview of Precision Agriculture in Dry-Land Cropping System at Akron, Colorado

Track: Adaptive Management of Conservation Efforts

Time: 1:00 PM - 2:30 PM CT

Authors: *Maysoon M. Mikha (USDA-ARS)*; Kyle Douglas-Mankin (USDA-ARS); David M. Barnard, USDA ARS*

Precision farming is considered an agricultural evolution in modern land management practices. The knowledge of land spatial variability enable the farmers and/or the researchers to generate maps of spatial variability for different aspects of soil properties. These maps can improve land sustainability to enhance yield and economic return. The objective of this study is to evaluate precision management decisions for optimizing inputs and enhancing land productivity. The study started in 2018 in Akron, Colorado on field size ranged from 6-acre to 11-acre with management practices (i) business-as-usual (BAU) of wheat-fallow rotation with reduce tillage (WF-RT) and (ii) Aspirational (ASP) of four years rotation with no-tillage and winter wheat-corn-millet-flex (WCM-Flex). Each phase of each rotation was included in each year with three replications. Soil samples were taken in a 30 m x 30 m equidistant sparing and each grid point was geo-referenced to generate field maps. Management zones were defined by crop yield and elevation. Veris-EC/pH for each field was obtained following the soil sampling. Soil water storage is being measured using neutron scatter at planting, crop physiological maturity, and during the periods between crops. The precipitation and other weather-related measurements are being evaluated using the on-site weather station and data collected by eddy covariance tower. Soil health parameters such as microbial community structure, aggregate size distribution, particulate organic matter (POM), and permanganate oxidizable carbon (POXC) is being evaluated. We observed high yield and elevation variability within each field. The advantages of precision management were not detected due to the short study duration. Overall, this project could provide a unique opportunity to evaluate precision farming practices for the dry-land in the central Great Plains Region.

**Denotes primary author*

Quantifying the Effects of Climate Change in the Central Mississippi River Basin: Ten Years of Study

Track: Adaptive Management of Conservation Efforts

Time: 1:00 PM - 2:30 PM CT

Authors: *Claire Baffaut (USDA–ARS)*; Sagar Gautam (Lawrence Berkeley National Laboratory); Quang Phung (University of Missouri); Allen Thompson (University of Missouri); Christine Costello (Pennsylvania State University); E. John Sadler (USDA-ARS (retired)*

Climate change analyses at the Central Mississippi River Basin site of the Long-Term Agroecosystem Research network started in 2012 with the objective of understanding the current and anticipated climate trends and their impacts on agriculture and water management. They have included independent analyses of current and expected climatic and hydrologic trends, but lack an overall integration of the results. This presentation synthesizes the results from these studies, which used varying downscaling approaches, global climate change models, and emission scenarios. The objective is to extract the most consistent and meaningful conclusions and identify promising strategies to mitigate the impact of climate change. Historical data showed increasing peak daily flows and number of zero flow days. All studies predicted a rise in projected temperature, for all seasons, for the near and far future. In contrast, early (CMIP 3) scenarios did not foresee any near future change in precipitation but later (CMIP5) medium and high emission scenarios predicted increased precipitation for both the near and far future, consistently over the spring months (March through June). Simulation of the combined effects of increasing temperature and precipitation showed more runoff and increased drought frequency and severity. Field scale adaptation measures included modifying rotations to include crops that could accommodate both dry and wet conditions. Watershed scale measures included enhancing water storage infrastructure, modifying the allowed uses for stored water, and converting some cropland to forest or grassland. Water resources managers can use these results to guide climate change adaptation in this region.

**Denotes primary author*

Conservation Agriculture and Supply Chain Development in the Kentucky Commercial Rye Cover Crop Initiative

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Scott Franklin (American Farmland Trust)**

Commercial-quality rye was once widely cultivated in Kentucky. Over the past several decades, however, production has almost entirely ceased in favor of the production of three primary crops – corn, soybeans, and wheat. To develop a network of farmers and buyers of cereal rye that reimagines cover crops to meet soil health and economic goals, American Farmland Trust partnered in the innovative 'Kentucky Commercial Rye Cover Crop Initiative' with the Kentucky Agricultural Development Fund, DendriFund, the University of Kentucky College of Food, Agriculture, and Environment, and the Kentucky Small Grain Growers Association.

In a 20-minute oral presentation at the SWCS Annual Conference, we will share our first-year results. Prior to 2020, Kentucky farmers grew limited amounts of cereal rye. Through this Initiative, Kentucky farmers are now growing 1,500-acres of cereal rye in 2021, with a goal of growing 10,000-acres by 2030. In addition to increasing rye acreage statewide, farmers are also trialing hybrid rye varietals against VNS varietals to test economic potential for the crop. The average hybrid yield on Kentucky farms is 60.1 bu/ac while VNS varietals yield an average of 35 bu/ac. Using new hybrid varietals, farmers can increase revenue by up to 90% over VNS rye or $10/ac over wheat cover. This Initiative has helped secure additional funding for a Soil Health Demonstration Trial through the NRCS Conservation Innovation Grant program. We will share soil health data and economic results from those farms.

The outcomes of this Initiative are significant since incorporating cereal rye into a cash crop rotation reduces soil loss, improves soil structure, and captures excess nutrients from previous crops. This Initiative also highlights how working collaboratively with farmers, businesses, non-profits, and academic institutions can support the development and growth of a small-grain economy rooted in cover crops that ultimately improves soil health and water quality.

**Denotes primary author*

Conservation Management Effects on Soil Function in a Transitioning Organic Cotton-Peanut Rotation

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Paul De Laune (Texas A&M Agrilife)*; Katie Lewis (Texas A&M Agrilife); Leah Ellman-Stortz (Texas A&M University); Terry Gentry (Texas A&M University)*

Texas is the leading producer of organic cotton and peanuts, growing over 90% of organic cotton and 95% of organic peanuts in the U.S. However, organic systems generally rely on tillage operations to control weeds and adoption of conservation tillage lags in conventional Texas cotton systems compared to other regions in the U.S. As digging peanuts for harvest is a destructive process, the feasibility of implementing cover crops and conservation tillage in these systems has been questioned. The objective of this study was to identify management practices that enhance soil function in both conventional and organic agriculture and share successful practices between these systems. Treatments included conventional cotton-peanut rotations with reduced tillage and 1) no cover crops, 2) rye cover crop, 3) radish cover crop, 4) rye/vetch cover crop, and 5) rye/vetch/radish cover crop. This system was compared to an organic cotton-peanut rotation with the same cover crops as evaluated in the conventional system but including a low and high seeding rate of each treatment. Initially, no-till was planned for the cotton systems, but crimping and rolling did not provide sufficient termination of the cover crop and subsequent weed control. Cover crops did not affect stand establishment of cotton or peanuts. Soil moisture was monitored and showed that cover crops resulted in a deficit of stored soil water at time of termination; however, stored soil water was restored compared to the no cover crop control by time of planting via precipitation or irrigation events and did not correlate to yields. Initial results indicated that C mineralization differed by location during the peanut growing season of 2020, where greater mineralized C was observed in conventional treatments at the Lubbock site and in the organic systems at the Vernon site. Initial results indicated that cover crops can be implemented in both conventional and organic peanut systems that lead to improved soil function.

**Denotes primary author*

Conservation Tillage and Cover Crop Management Practices in Potato Production to Improve Soil Health and Probability

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Mohammad Khakbazan (Agriculture and Agri-Food Canada)*; Judith Nyiraneza (Charlottetown Research and Development Centre, Agriculture and Agri-Food Canada); Yefang Jiang (Charlottetown Research and Development Centre, Agriculture and Agri-Food Canada); John Huang (Agriculture and Agri-Food Canada)*

In the humid climate of Prince Edward Island (PEI), Canada, fall moldboard plowing of forage before potato in a typical barley–forage–potato rotation and bare soil after potato harvest increased the risk of nitrate leaching and topsoil loss due to erosion. Data from two experimental studies in PEI during 2009–2016 and 2016–2017 were assessed to determine the effects of conservation tillage (including delaying fall plowing from fall to spring or using residue tillage equipment to replace moldboard plough) after forage and before potato and three winter cover crops after potato to evaluate economic returns and risk of returns trade-offs for potato producers. Two cover crops after potato are used as cash crops (winter rye, winter wheat), and one is a winter-killed cover crop (spring barley). Factors related to conservation tillage such as soil erosion, nitrate leaching, planting date, effect on weeds, insects and diseases, potato harvest loss, and labor constraints were quantified. In a study with conservation tillage before potato, potato yields were the same for fall or spring plowing; however, residue tillage management produced higher potato yield compared to conventional fall moldboard plowing. Results showed residue tillage management and late fall plowing was preferred over spring plowing. Although spring tillage provides reductions in the risk of soil erosion and nitrate leaching, it also affects production risk and uncertainty. Therefore, farmers prefer plow forage as late as possible in the autumn or replace it with residue tillage equipment to reduce the risk of topsoil loss. In a study with winter cover crops after potato harvest, winter wheat grain yield ranged from 4.5 to 7.6 Mg ha^{-1}, while that associated with winter rye ranged from 3.2 to 5.1 Mg ha^{-1}. Therefore, winter cereal seeded after potato harvest can constitute a good source of revenue while mitigating the risk of soil erosion and reducing nitrate leaching in some cases.

**Denotes primary author*

Cover Crops and Specialty Crop Agriculture: Exploring Cover Crop Use among Vegetable and Fruit Farmers in Michigan and Ohio

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Ethan Schoolman (Rutgers University); J. G Arbuckle (Iowa State University)**

Specialty crops are both increasingly important to the U.S. agricultural economy and increasingly vulnerable to climate change. Planting cover crops is an agricultural conservation practice that performs multiple agroecosystem functions relevant to buffering farms from the impacts of climate change. Yet far less research has been conducted on cover crop use by specialty crop farmers, compared to the much larger body of research on farmers who grow principally field crops. In this study, we draw on survey data from a stratified, random sample of specialty crop growers in Michigan and Ohio to accomplish two main goals. First, we seek to characterize cover crop use among this important group of farmers, focusing on types of cover crop used and use of multiple types. Second, we examine the relationship between cover crop use on vegetable and fruit farms and key social and economic factors, with particular attention to farmers' environmental values, adherence to organic principles, and sources of information. Survey results suggest that (1) specialty crop producers in Michigan and Ohio appear to be using cover crops at a significantly higher rate than their field crop-producing peers, (2) cover crops are thoroughly integrated into organic specialty crop operations, and (3) cover crop use is strongly related to attitudes regarding soil heath. Relatively widespread use of cover crops among specialty crop growers constitutes an important step toward resilience in the face of climate change and extreme weather. Findings from regression models also suggest that agribusiness actors are facilitating cover crop use among specialty crop producers. Better understanding of this dynamic may inform outreach to agricultural retailers and consultants in the field crop realm.

**Denotes primary author*

Assessment of an Arkansas Discovery Farm in the Eucha-Spavinaw Watershed Concerning Wastewater and Manure Management for Full-Time Dairy Production

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

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

Wastewater and manure management from dairy operations in northwest Arkansas continues to be an issue for area farmers. The Haak Dairy Farm is a cattle operation located in Benton County, Arkansas milking up to 160 cows with a rotation of forage and crops. The farm includes a pre-milking holding area, where manure is mixed with sawdust and moved to an open-air storage facility and a milking center, where solids are removed before washing. The mix is then pumped to a concrete settling basin. The liquid fraction flows into a trench that allows transport of liquid into adjacent vegetation. Liquid manure samples were collected from March 2017 to November 2020 and water extractable phosphorous (WEP), total nitrogen (N), total phosphorus (P) and total potassium (K) in milligrams per liter (mg/l) determined. There were three sampling locations; the settling basin, the trench entrance, and a downhill pond. A student's t-test (P = 0.05) showed significant differences among all three areas in nutrient content in the order of: trench entrance > settling basin > downhill pond, indicating the trench is limiting nutrient migration. Soil sampling events in 2017, 2018 and 2020 showed 2018 and 2020 having significantly higher soil test P (STP) than 2017 within identified transects of the field, but decreased in STP in transects near the downhill pond. Water-meter readings indicated the highest usage of farm water was for cattle drinking. Manure/sawdust mixture temperatures (74°F) were higher than ambient air temperatures, but have not reached composting temperature (130°F). Core samples of the manure/sawdust mixture were collected in 2020 and analyzed for chemical and physical characteristics while showing no significant trends. Monitoring of the wastewater treatment system, trends in STP, and characteristics of the manure/sawdust mixture needs to continue in order to assess the long-term effectiveness of the dairy's wastewater and manure management system.

**Denotes primary author*

Practical Applications of In-Situ Green Canopy Cover

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

Authors: Andres Patrignani (Soil Water Processes, Department of Agronomy Kansas State University)*;Tyson E. Ochsner (Applied Soil Physics, Department of Plant and Soil Sciences, Oklahoma State University)

This presentation will cover the motivation for the Canopeo app and applications of downward-facing images to track crop growth, detect plant responses to abiotic stresses, and adjust the evapotranspiration partitioning in soil water balance calculations. This presentation is aimed at field agronomists, soil conservationists, and scientists interested in quantifying the fraction of ground surface covered by actively growing vegetation using point-and-shoot cameras, time-lapse cameras, and mobile devices.

**Denotes primary author*

South Sound Discovery Farms: Researching Manure Management Treatments for Water Quality in King County, Washington

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

Authors: *Courtney Naumann (American Farmland Trust); Addie Candib (American Farmland Trust)**

American Farmland Trust, King Conservation District, and Discovery Farms Washington, with funding from Department of Ecology, partnered to lead an innovative research project called South Sound Discovery Farms to measure the impact of manure storage treatments on water quality.

Conservation practices installed on farms have many benefits. Proper manure management practices for animal operations, particularly those that contain and control manure runoff, protect water quality by retaining valuable nutrients and preventing transport to surface and ground water resources. While research exists to show the benefits of best practices for manure storage, much of the research is based outside of the Pacific Northwest region. The South Sound Discovery Farms project fills a unique information gap for farmers as it has resulted in accessible, scientific data to guide manure management specific to Washington's climate and soil conditions.

With input from local farmers, the project installed different treatments of dry manure storage, including with and without roofs and permeable floorings, at two sites. The project measures environmental data from four different treatments of dry manure storage to assess the level of surface or ground water protection. It compares various combinations of tarp coverings, roofs, and concrete floorings as compared to uncovered piles (controls).

Water, soil, and manure are being tested to understand potential impacts from treatments which is very important in Washington for salmon habitat and water quality protection. Preliminary data has been collected and some key patterns have emerged. The first shows that the "signature" of manure is the same between piles and its runoff. The second shows that good management is imperative for quality manure storage. Ongoing data collection will continue to highlight the importance of manure management on small-scale farms and amplify the need for future funding to support farmer-led research projects.

**Denotes primary author*

Exploring the Culture of Agriculture: A Course on Food System Equity

Track: Justice, Equity, Diversity, and Inclusion

Time: 1:00 PM - 2:30 PM CT

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

Increased attention on racial equity in the United States creates an opportunity to expand dialogue on equity in agriculture. This presentation will discuss a novel short course developed at the University of Nebraska-Lincoln in 2020 focused on diversity, equity and inclusion in the food system. The goal of the course was to explore the norms, values and history of agriculture in the United States, and how this has supported and/or inhibited the voices typically with "seats at the table". The three week mini-session course arose out of a shift in the academic calendar due to COVID-19. The course was offered online asynchronously for undergraduate and graduate students in November-December 2020. Feedback from students was overwhelmingly positive; students noted that they greatly appreciated the content, did not have exposure to this history and information in other courses, wished such a course was required of all students and that it could easily have been a full semester endeavor. Additionally, concurrent discussion sessions were held with nearly two dozen faculty and staff interested in "following" along with the course. A number of other internal and external conversations have followed the course, including how it may be expanded for faculty/staff professional development and how to stimulate more diversity, equity and inclusion examples throughout the curriculum within the College of Agriculture and Natural Resources at the University of Nebraska-Lincoln. The course content and themes may serve as an example for others looking to start or expand conversations at other organizations or institutions. Within every institution, state, and region, there are histories of inequities and cultures of exclusion that require interrogation. This is necessary if we, as an agriculture and conservation community, are ever to truly support more inclusive spaces and create seats at the table for all.

**Denotes primary author*

Promoting Justice, Equity, Diversity, and Inclusion Competency in the Next Generation of Conservation Professionals

Track: Justice, Equity, Diversity, and Inclusion

Time: 1:00 PM - 2:30 PM CT

Authors: *Erin Silva (UW-Madison)**

With increasing awareness that reaching global conservation goals hinges on our ability to create policy and education addressing issues of justice, equity, diversity and inclusion, it is imperative that our next generation of conservation researchers, educators, policymakers, and professionals are poised to address these challenges. The tools to move forward in pursuit of a more just and equitable land management system include not only an understanding of the history and actions that have brought us where we are today, but the current experiences, stories, and cultural context within which injustice and inequity still reside. In Spring 2021, a graduate level course was established at the University of Wisconsin-Madison to create space to begin to address these issues as related to graduate students pursuing degrees in agricultural fields. Named "Race and Equity Issues in Agricultural Research and Education", the course engaged a series of researchers, educators, practitioners and professionals to reflect upon their own experiences, shared history, and paths forward. This presentation will discuss the structure of the course, as well as observations regarding the successes and challenges of planning these types of learning environments.

**Denotes primary author*

Recognizing the Contributions of Latinos in Rural Indiana and Wisconsin

Track: Justice, Equity, Diversity, and Inclusion

Time: 1:00 PM - 2:30 PM CT

Authors: Bill Berry

Efforts to recognize the contributions of the Latino community in rural Indiana and Latino agriculture workers who have settled in Wisconsin will be highlighted by two longtime conservationists, farmer and social activist Ray McCormick of Indiana and conservation communicator/journalist Bill Berry of Wisconsin. McCormick will focus on Festival Latino, an annual event he spearheaded to draw attention to and celebrate the contributions of the Latino community to the cultural fabric of rural Indiana. Berry will address a project of the Wisconsin Humanities Council in which he interviewed immigrants from south of the U.S. border who now work in the agricultural industry in south central Wisconsin.

**Denotes primary author*

Spheres of Liminality and Discourse as Precursors to Indigenizing Circular Economy Approaches to Sustainable Development Goal 2.5

Track: Justice, Equity, Diversity, and Inclusion

Time: 1:00 PM - 2:30 PM CT

Authors: *Mervyn L. Tano (IIIRM)**

The International Institute for Indigenous Resource Management has long been concerned about the loss of diversity of wild populations of many native plants. Habitat loss reduced range and number of plants. Valuable foods and medicines are lost through unsustainable foraging practices and genetic degradation. Seed collections and storage are important for maintaining ecosystem biodiversity and genetic diversity as are: controlling invasive animals and plants; protecting birds, bats, and insects that control pests and diseases; expanding habitat; protecting pollinators and seed dispersers.

Thus far, our efforts to preserve and promote the objects of Sustainable Development Goal 2.5 include courses on:

- Traditional healer roles in protecting biodiversity;
- Indigenous gastronomies and food security/sovereignty;
- Circular approaches to SDG-2.5.

We argue the Circular Economy paradigm, as currently defined, is inapposite when applied to relationships, responsibilities, building human, social, and cultural capital, and nation-building—foundational principles in indigenous definitions of sustainable development. We describe the web of actors implicated in achieving the ends of SDG-2.5 and suggest spheres of liminality and discourse guided by principles such as Kuleana, Lokahi, Aloha Aina, Kaitiakitanga, and Whakapapa as the first step in indigenizing the CE paradigm.

**Denotes primary author*

A Social Cognitive Theory and Self-Determination Theory Approach to Understanding Farmers' Adoption of Nutrient Management Best Management Practices

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Lijing Gao (Iowa State University)*; J.G. Arbuckle (Iowa State University)*

The Iowa Nutrient Reduction Strategy (NRS) aims to reduce nutrient loads in waterways from nonpoint sources such as farm fields. Farmers' voluntary adoption of soil and water conservation practices is crucial to achieve the NRS goals. Although the Iowa NRS has been active since 2013, farmer participation and net pollutant reductions have been insufficient. Therefore, continued efforts to understand the motivations and barriers that underlie farmers' conservation actions in a comprehensive and integrated manner are needed to help improve outreach strategies. This research employed social cognitive theory and self-determination theory to study the relationship between the dynamic precursors and later modifiers of adoption of four nutrient management practices. Data are from the 2014-2017 Iowa Farm and Rural Life Poll. This study shows that that self-efficacy, response efficacy is a positive predictor of innovative nutrient management practice adoption. Perceived economic pressure has a positive influence on context specific practices. The results also indicate that stewardship motivations and use of crop insurance were associated with an increased probability of adoption of all four practices. This research provides innovative insights for policy making, extension agencies, and other researchers concerning the nutrient management practices adoption.

**Denotes primary author*

Individual and County-Level Influences on Iowa Farmers' Use of 4Rs Plus Soil and Water Conservation Practices

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Suraj Upadhaya (Iowa State University)*; J.G. Arbuckle (Iowa State University); Paige Frautschy (The Nature Conservancy (TNC))*

The 4Rs Plus approach to nutrient management--applying the right source of nutrients, at the right rate, at the right time, and in the right place combined with "Plus" conservation practices such as no-till and cover crops--is a science-based framework designed to guide improved nutrient management and nutrient loss abatement while improving soil health. Adoption of 4Rs Plus can lead to win-win outcomes in terms of both boosting productivity and minimizing the environmental impacts of farming. However, the adoption of this framework is below the expectation. Using data from a survey of 6006 Iowa farmers we employ Multi-Level Modeling to assess the influence of diverse individual and county-level social, economic, and ecological factors on adoption of 4Rs Plus practices. Results show that several individual-level (e.g., influence of different information sources) and county-level variables (e.g., percent rented land, average slope) have fairly consistent explanatory effects across 4Rs and Plus practices, while others (e.g., average crop insurance) only influence Plus practices. Results may guide efforts to increase adoption of 4Rs Plus practices to help improve soil and water conservation outcomes.

**Denotes primary author*

The Social Factors Influencing Cover Crop Adoption in the Midwest: A Controlled Comparison

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Ruxandra Popovici (Purdue University); Mazie Bernard (Purdue University); Kris Johnson (The Nature Conservancy); Pranay Ranjan (Purdue University); Emily M. Usher (Purdue University); Linda Prokopy (Purdue University)**

In spite of increased funding and resources available for planting cover crops (CCs), their adoption across different counties in the Midwest has been uneven. This study builds upon Operational Tillage Information System (OpTIS) data on CC adoption trends at the county level. Within the same climatic region, there are some counties with higher (and lower) levels of CC adoption than others. Our study seeks to better understand the social factors that contribute to CC adoption in the states of Iowa, Illinois, and Indiana. To date, most studies analyzing social factors have been conducted by assessing individual producers' perspectives through surveys and interviews. In contrast, our study seeks to explain the county-level factors that motivate CC adoption. To achieve this, we compared pairs of neighboring counties where one county had a higher rate of adoption and the other had a lower rate of adoption of CCs. By comparing neighboring counties within the same climatic areas, we sought to control for the variation in climate, soil type, and topography. Within each county, we conducted interviews and focus groups with personnel of conservation agencies, farmers, crop advisors, and other relevant actors, which gave us a clearer understanding of the social factors responsible for the difference in CC adoption levels between each county pair. Our results indicate that the higher levels of CC adoption in some counties could not be attributed to one single factor. Rather, counties with higher CC adoption presented a "cluster" of social factors that together increased adoption over time. These factors include: early adoption of CCs, a CC "culture", programs beyond EQIP and CSP, NRCS and SWCD employees promoting CCs beyond their regular duties, and collaboration between organizations and individual entrepreneurs. Implications for CC outreach will be discussed.

**Denotes primary author*

Why do Farmers Adopt Soil Conservation Practices? A Theoretical Framework and Literature Review

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Ogieriakhi Macson (Texas A and M University)*; Woodward Richard (Texas A and M University)*

As soils across the globe continue to face problems of severe degradation and loss under current management practices, there is great need to study soil conservation decisions such as no-till (NT). In this paper we consider the question of why farmers choose to adopt no-till by developing a new and comprehensive dynamic optimization model which takes into account nine key factors that affect a farmer's choice, given the state variables surrounding them. To this end, based on focus groups and surveys of farmers, we develop a mathematical model that can be used to identify a range of factors that are behind a farmer's adoption decision. We then review the literature to examine what has been learned about each of these factors.

We show that the farmer's choice can be thought of as the solution to a dynamic optimization problem. We then show that farmers' decisions will be affected by 1. profit realized from adoption of no-till, 2. benefits of high yield that are not captured in utility from profits, 3. utility derived from government payments, 3. perceived benefits derived from soil stewardship, 4. environmentalism and social interactions, 5. the effect of land tenure on decision to adopt, 6. the extent to which adoption decision affects the farmer's future access to the field, 7. the extent to which farmers value changes in soil health characteristics, 8. the extent to which the farmer believes that no-till is a viable farming practice that improves soil health and 9. aversion to risk.

This paper addresses salient issues pertaining to soil health and conservation; issues which are of great interest to SWCS members. By providing an expanded theoretical model of the NT adoption decision and pooling together extant studies of the factors that affect this decision, we are able to establish a nexus between what we already know about the decision process of farmers with respect to no-till and what we do not know, thus establishing important areas for future research.

**Denotes primary author*

23 Years of Agroforestry on SOC on Agricultural Watersheds under a Corn–Soybean Rotation

Track: Adapting Landscapes to Climate Change

Time: 3:00 PM - 4:30 PM CT

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

Unsustainable agricultural practices reduce soil organic carbon (SOC), affecting ecosystem services, land productivity, and soil quality and water quality. This study evaluated the long-term effects of row crop (RC), agroforestry buffers (AB), grass buffers (GB), and grassed waterways (GWW) on SOC. Agroforestry buffers (grass and tree) and grass buffer treatments were established in 1997 on a corn (*Zea Mays* L.)-soybean (*Glycine Max* L. Merr.) rotation. Grid soil samples from 86 locations were collected in 10 transects to determine SOC for 0-10 cm and 10-20 cm depths. Geospatial statistics and ANOVA were conducted to evaluate treatment, depth, landscape, and soil type effects on SOC. The mean SOC% in the top 10 cm depth for the RC, AB, GB, and GWW areas was 1.94%, 2.19% 2.41%, and 2.51%, respectively ($\rho < 0.001$). The depth effects caused significant differences ($\rho < 0.001$) between samples from 0-10 cm and 10-20 cm. The mean SOC% among soil series showed no statistically significant differences at the studied depths. The mean SOC percentage from 0-10 cm for RC, AB, GWW were 1.85%, 1.88%, and 2.30% in 2000, and 1.94%, 2.19%, and 2.51% in 2020. The SOC% in the RC treatment from 0-10 cm at the summit, backslope and foot slope positions were 1.83%, 2.22%, and 2.31%, respectively ($\rho < 0.05$). Results indicate that perennial vegetation and undisturbed land management increased the SOC compared to the crop areas and the SOC within the treatments increased from 2000 to 2020. Also, depth and landscape positions played a significant role in SOC spatial distribution.

**Denotes primary author*

Soil Greenhouse Gas Emissions from a Texas Vertisol under Differing Tillage Practices

Track: Adapting Landscapes to Climate Change

Time: 3:00 PM - 4:30 PM CT

Authors: *Dorothy Menefee (USDA-ARS)*; Hal Collins (USDA-ARS)*

Agricultural soils can be a source of greenhouse gas emissions depending on soil type and management decisions. Greenhouse gases (CO_2, CH_4, and N_2O) were monitored over the course of a growing season and a fallow season for corn and cotton in a central Texas Vertisol with differing tillage practices. Microbial analysis via PLFA was also performed at multiple dates through the growing and fallow seasons. The study is set up with four replicates of each tillage treatment (No-Till, Strip Till, and Conventional Till) in each crop (corn and cotton). The results of this will be presented at SWCS.

**Denotes primary author*

Soil Pore Response to Tile Drainage

Track: Adapting Landscapes to Climate Change

Time: 3:00 PM - 4:30 PM CT

Authors: *Hida R. Manns (Trent University)**

There are many studies on how tile drainage influences water diversion of rainfall over the plant growing seasons in relation to streamflow flow rates/volume and trends over time. Rainfall runoff ratios assimilate the changes in land absorption of rainfall as a consequence of changes in farming practice, land cover, or infrastructure. Although soil pores are instrumental in water holding capacity vs drainage in soil, they are seldom included in tile drainage literature, nor is the process of change in soil pores over time with reduced anoxic inundations documented. Along with tile drainage comes the expectation of increased plant growth. Increased productivity can only result from improved soil/water balance in the plant root zone, resulting in increased root length, microbial activity and consequently plant growth and yield. Soil pores are the operative mechanism by which soils adjust their bulk density and manage the balance of increased soil carbon and soil mineralization for nutrient acquisition. This presentation will detail how the soil mechanism must work to make tile drainage worthwhile for the farmers. The value of 'pore it or pool it' will be discussed. This snowball effect of sub surface tile drainage may be valuable for improving tile drainage models, and in addition to understand the role of subsurface drainage in stream flood planning.

**Denotes primary author*

GIS-Based Indices in Soil and Water Conservation

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *Anh K.V. Bui (Ho Chi Minh City University of Natural Resources and Environment)**

Surface runoff reduction is the goal of soil and water conservation in agricultural watersheds. Through the surface runoff, many substances of soil such as sediment, nutrient of soil added in nitrogen and phosphorus compounds, contaminants, and even moisture have been eroded to end up in streams, rivers, and lakes. In decades, studies have revealed various mitigation, including structure and non-structure conservation ranging from field scale to watershed scale. However, the challenging for effectiveness improvement has been become more and more increased in the recent years. Particularly, the impacts of anthropogenic activities, including land use and land cover changing, associate with the fluctuation in weather conditions. As a result, the runoff generation has been changing in both terms of volume and variable areas of runoff generation.

From the understanding of runoff generation mechanism, including infiltration excess and saturation excess, this study is conducted with the objective to propose an application of GIS – based indices in identifying the areas with high runoff propensity. The method is using GIS-based data to derive the ranking map of potential high runoff areas.

**Denotes primary author*

Impact of Conservation Practices and Soil Physical Properties on Field Hydrology: How Sensitive is the Soil Plant Atmosphere Water (SPAW) Model to Changes in Soil Properties?

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

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

Implementation of practices which improve hydraulic properties of soil will result in reduced runoff and increased infiltration. These changes can alter modeling outputs for commonly used techniques. The Soil Plant Atmosphere Water (SPAW) model simulates daily water balance from crop systems. This model is widely used by the Natural Resource Conservation Service (NRCS) to size impoundments. If runoff varies significantly due to variables that are assumed or assessed without field confirmation, model applications could result in significant error. This study assessed the change in the ratio of runoff to precipitation for various soil, cover crop, and weather treatments. Soil profiles in 135 combinations were developed with three soil classes (sandy loam, silt loam, and clay), five organic matter levels (1%, 2%, 3%, 4%, and 5%), three levels of compaction (low, medium and high), and three topsoil layer thicknesses (3'', 4.5'' and 6''). Also, three cover crop treatments were simulated by modifying surface cover and evapotranspiration. Finally, two precipitation regimes were considered (Iowa City, IA, as high precipitation and Brookings, SD, as low precipitation). In total, 810 scenarios were run resulting in over 300 million data points. This study confirmed that soil texture, bulk density, and topsoil thickness significantly influence runoff-precipitation ratio and infiltration-precipitation ratio ($p<0.01$). Interestingly, organic matter level (1% to 5%) had no significant effect on runoff. Cover crop scenarios had reduced runoff-precipitation ($p<0.01$) and increased infiltration-precipitation ($p<0.05$) ratios compared to no cover crop. This simulation demonstrates that runoff estimations can be significantly influenced by properties that can change due to soil health practices. Models must account for these changes rather than relying only on historical or remote sensing inputs.

**Denotes primary author*

Integrating Fuzzy Logic Riparian Management Decision Support in the Upper Mississippi River Basin

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *Saumitra Rai (Birla Institute of Technology and Science, Pilani); R. Srinivas (Birla Institute of Technology and Science, Pilani)*; Joe Magner (University of Minnesota)*

Riparian corridors serve as buffer zones between land and water supporting important ecosystem services. Though riparian zones occupy around 1% of land area in midwestern watersheds, their management has significant consequences on the larger catchment area and water quality downstream. Riparian functions are influenced by riparian characteristics and management practices. Management of riparian zones in the upper Mississippi River basin has typically been lacking because there is little to no incentive to invest time and resources by landowners. Yet, there can be a large societal benefit to downstream water quality and the associated ecosystem services.

This study attempts to classify riparian zones based on three categories: stream features, riparian characteristics, and riparian functions to prioritize management action. Fuzzy Analytical Hierarchy Process (AHP) employing Buckley's method was used to identify critical parameters under each of these three categories individually. These critical parameters were then analyzed under MATLAB-based Fuzzy inference system (FIS) to recommend riparian management practices for a given stream reach.

Fuzzy logic accommodates the uncertainty involved in the perspectives of multiple characteristics by assigning membership functions to riparian variables, while also accounting for continuous variation in riparian dynamics which cannot be achieved by employing definitive crisp values. We present a case study of the Upper Mississippi River basin to demonstrate the approach. The outcomes of the study could guide watershed managers in decision support for limited financial resource allocation.

**Denotes primary author*

Using Surge Valves to Increase Irrigation Efficiency and Reduce Nutrient Loss in Furrow Irrigation

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *Lee Riley (Univ. of Arkansas); Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service); Mike Hamilton (University of Arkansas); Michael Freyaldenhoven (University of Arkansas System Division of Agriculture); Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service)**

Farming is under increasing pressure to reduce environmental impacts and become more sustainable. Many farmers are already monitoring their nutrient and water inputs to get the best agronomic return. With conservation practices like cover crops and irrigation efficiency management practices such as computerized hole selection (CHS) furrow irrigation with poly tubing, what can be done to improve an already efficient irrigation system? Surge irrigation has the potential to increase irrigation efficiency. Surge irrigation automatically alternates full well capacity to portions of a field, to providing a surge of irrigation, followed by resting, to allow water more time to soak into the soil profile. Using a surge valve to alternate irrigation water distribution should increase irrigation water infiltration and reduce tailwater losses. Surge irrigation was implemented on one half of a CHS irrigated, row crop field, and compared to the other half of the same field's already fairly efficient CHS irrigation. Irrigation volumes were determined with two independent turbine-type flow meters, soil moisture sensors were used to determine irrigation water infiltration into the soil profile at 6, 12, 18, and 30 inch depths, and automated edge-of-field water monitoring equipment were used to determine tailwater losses. Surge irrigation increased irrigation efficiency, and reduced nutrient loss. Initial data showed, that while 0.8" less irrigation water was applied to the control than the treatment, the surge valve increased the effective irrigation (water that stayed in the field) by 4.25". The surge valve increased the irrigation efficiency by 20% and reduced nutrient and soil loss by half in tailwater. Surge valves are another tool that can help farmers increase sustainability.

**Denotes primary author*

Multi-Element Soil Composition at Depth Influence Prairie Pothole Wetlands

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Carrie Werkmeister (USDA-NRCS)*; Larry J. Cihacek (North Dakota State University); Donna Jacob (Houston Engineering); Marinus Otte (North Dakota State University)*

In the Prairie Pothole Region (PPR), impact of landscapes within wetland ecosystems has been recognized but there is limited understanding of how soils on landscapes influence wetland multi-element chemistry concentrations at depth. This knowledge aids development of wetland/landscape restoration strategies and provides information for future guidelines on wetland management within landscape settings. Objectives of this study were to: (1) identify differences or similarities in biogeochemical characteristics of footslope (FS) and backslope (BS) soils in PPR wetland ecosystems; and (2) interpret soil chemistry reflected by undisturbed footslope (UFS) and undisturbed backslope (UBS) and disturbed footslope (DFS) and disturbed backslope (DBS) emphasizing differences between landscape positions and linking these to findings in our previous work. Six DFS, DBS, and six UFS, UBS adjacent to and influencing North Dakota PRR wetlands were evaluated. Using redundancy analysis (RDA), resulting environmental variables (EV) models of element concentrations to a 1 m depth were generated. RDA ordination plots of element concentrations in UFS to depth of 1 m was constrained by one set of variables (sand, pH, depth, site, bulk density (BD)) while in DFS, a different set of variables (site, pH, EC) provided constraint. This was similar for UBS (sand, pH, depth, BD, silt/clay) but DBS showed effects of a different set of variables (site, EC, depth, organic matter, pH). Our research indicated anthropogenic activities on landscapes in DFS and DBS likely influenced subsurface hydrology but soils differed in physical and chemical properties from UFS and UBS. Differences appear to be influenced by unique chemical and physical characteristics of underlying calcareous glacial till parent materials. Thus, their “site” EV reflects anthropogenic influences on surrounding landscape for DFS and DBS. Based on this research, landscape effects need to be considered in wetland restoration strategies.

**Denotes primary author*

Nitrous Oxide Emissions from Agricultural Soils: Sources and Mitigation Options

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Nithya Rajan (Texas A&M University)**

The N cycle is a dynamic nutrient cycling process in the biosphere involving both plants and microorganisms. Major alterations to the global N cycle have happened since the early 20th century with the discovery of the Haber-Bosch process which made synthetic N fertilizers available in agriculture. Only 30-50 percent of N applied to the agricultural fields as synthetic fertilizers is utilized by crops. The rest is lost to the environment through volatilization or oxidation and reduction processes resulting in emission of gases such as nitrous oxide (N2O). Current estimates show that agricultural practices are responsible for approximately 79% of total anthropogenic emissions of N_2O in the US. Nitrous oxide molecules stay in the atmosphere for an average of 114 years and are approximately 300 times more powerful than CO_2 as a greenhouse gas. Current methods to curb agricultural N losses include precise application of fertilizers and use of synthetic nitrification inhibitors. An alternate method for curbing nitrification and N_2O emission is Biological Nitrification Inhibition (BNI). Latest research on BNI will be presented at the meeting.

**Denotes primary author*

Soil Conservation Practices Impact Proximal Controls for N2O Production and Consumption in Semiarid Crop

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Mark D McDonald (Texas A&M University)*; Katie Lewis (Texas A&M Agrilife); Terry Gentry (Texas A&M University)*

Soil conservation practices for reducing wind erosion have been a hallmark of management decisions on the Southern High Plains for decades. These practices have a direct effect on the agronomic productivity and impact biochemical processes such as the nitrogen (N) cycle. Alterations to the N cycle in croplands can have global effects as N cycling in agriculture is the major source of nitrous oxide (N_2O), a potent greenhouse gas. This study analyzed soil chemical and biological impacts of conservation systems and N fertilizer management at three key cotton growth stages (vegetative, Veg; Peak plant growth, Peak; Reproductive growth, Repro) in a semi-arid agricultural system known to produce N_2O. Soil samples were collected at a 0-10 cm depth at the key growth stages. This split plot study used conservation practices (tillage and cover crop regime) as the main plot and N fertilizer application timing as the split plot. Soil N_2O emissions, soil nitrate-N (NO_3^--N), mineralizable carbon (C), and gravimetric water content were measured. Finally, the genetic potential for denitrification (nirK and nirS) and N_2O consumption (nosZ clade I and II) was evaluated via qPCR to fully elucidate potential proximal and distal factors related to N cycling. Initial analysis indicates conservation systems affected C mineralization at Peak and Repro in 2018. Conservation system was determined to affect soil NO_3^--N at Peak 2018, and Veg, Peak, and Repro 2019. Timing of N fertilizer did not affect GWC or C mineralization but did affect NO_3^--N concentration at Peak 2019. Preliminary analysis also indicated gene abundances for total bacteria (16S) and N_2O consumption (nosZ clade II) were not affected by conservation system or N treatment for any growing season in 2018 and 2019. Final analysis will include data from 2020 and will help determine the relationship between changes in soil chemical parameters and N cycling gene abundance due to conservation practices.

**Denotes primary author*

Soil-Test K Spatial Variability and K Loss via Water Runoff in Arkansas

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Matt Fryer (University of Arkansas System Division of Agriculture Cooperative Extension Service)*; Lawrence G. Berry (University of Arkansas); James M Burke (University of Arkansas); Pearl Webb (University of Arkansas System Division of Agriculture Cooperative Extension Service); Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service); Andrew Sharpley (University of Arkansas); Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service); Nathan Slaton (University of Arkansas)*

The Arkansas Discovery Farm Program has primarily been documenting nitrogen and phosphorus loss via edge of field water runoff on real working farms since 2010 by utilizing state-of-the-art automated water sampling equipment. Potassium (K) loss documentation in water runoff was initiated in 2017 to better understand K loss potential in water runoff and lead to increased farm profitability and efficiency. Although little is known about K loss potential via water runoff, less is known of the relation of soil-test K (STK) spatial variability to K loss in water runoff. Four Arkansas Discovery Farms encompassing ten sites managed for either forage, cotton, or poultry production were utilized in this soil and water sampling study. Sites were grid soil sampled in 2019 showing the highest STK values at the lowest elevations or drainage points in the cotton and forage production sites while the highest levels for poultry production sites occurred in front of poultry houses. Across sites, mean STK values for the 0-to 4 (forage and poultry sites) - or 0-to 6 (cotton sites) -inch sampling depth ranged from 83 to 264 ppm K. Monitoring of K loss in water runoff from 2017 to 2019 showed mean K concentrations ranging from 3.4 (cotton site) to 21.2 mg /L (poultry site) and area losses ranging from 1.0 (forage site) to 67.0 kg K/ha/monitoring year (poultry site). Loss of K via water runoff can be economically substantial and can potentially explain in part why STK is declining in some fields over time. A better understanding of STK spatial variability and the potential relationship between K loss in water runoff will ultimately lead to greater farm profitability and sustainability in the area of K fertilizer management.

**Denotes primary author*

Wednesday, July 28

Oral Presentation Descriptions

Addressing Information Gaps to Better Guide Land and Water Conservation Practices in the Mississippi River Basin Using the Great Lakes to Gulf Virtual Observatory Platform (GLTG)

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Authors: *Edward Kratschmer (Lewis and Clark Community College)**

Information gaps, including data availability, integration, standardization and interpretation, hinder evaluating the effectiveness of widespread land and water conservation efforts and guiding related policies and practices. The Great Lakes to Gulf Virtual Observatory (GLTG) addresses the integration of water quality data with information on agricultural conservation practices that target nutrient loss reduction on farmland in the Mississippi River Basin (MRB). The GLTG's web-based spatio-temporal application allows users to dynamically browse, search for, and visualize water quality information in the MRB from state, federal and NGO sources. The application also provides geospatial contextual layers such as land use, precipitation, annual nitrogen fertilizer use, SPARROW Model outputs and the annual hypoxic zone in the Gulf of New Mexico

GLTG has standardized data at HUC8, state, and regional scales describing these farm conservation practices. Using remote sensing, ground truthing and calibration, GLTG is repositing fine scale temporal, field level data describing tillage practices, cover crops, drainage, and other information describing agroecosystems and cropping; and providing water quality data integration, analyses, and visualizations of water quality trends for selected sites in conjunction with MRB states and the Hypoxia Task Force.

This unique data set provides an opportunity to develop decision support tools that will help evaluate and guide future land and water conservation practices and policies. We provide examples of emerging decision support tools supported by GLTG, a collaboration between the National Great Rivers Research and Education Center (NGRREC), National Center for Supercomputing Applications (NCSA), and the Illinois-Indiana Sea Grant Program (IISG) at the University of Illinois.

**Denotes primary author*

Assessing How Combined Best Management Practices Mitigate Algal Blooms Using Algal Nutrient Limitation Threshold

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Authors: *Richard E. Lizotte (USDA)*; Matthew Moore (USDA); Martin Locke (USDA-ARS); Lindsey Yasarer (USDA-ARS); Jason Taylor (USDA); Ron Bingner (USDA)*

Eutrophication continues to be a challenge in agricultural watersheds. Quantifiable reductions in nutrients with best management practices (BMPs) have been documented, but issues with harmful algal blooms persist. Understanding watershed-specific nutrient thresholds eliciting algal blooms is critical in determining the effectiveness of BMPs in mitigating eutrophication. The current study builds on previously demonstrated reductions in nutrients in a CEAP watershed, Beasley Lake, in western Mississippi. The CEAP watershed has five established structural BMPs: edge-of-field vegetated buffers strips; Conservation Reserve set-aside (CRP); constructed wetland; mixed-vegetation bobwhite quail (Colinus virginianus) habitat buffers; and a vegetated sediment retention pond. Lake algal biomass (as chlorophyll a) and nutrients (NO_3-N, TN, PO_4^{-3}, TP) were monitored biweekly from 1998-2019. Lake algal nutrient limitation and thresholds were determined using laboratory bioassays and compared with long-term monitored lake nutrients and summer chlorophyll a (1998-2019). Algal nutrient bioassays indicated varying nutrient limitation from nitrogen+phosphorus to nitrogen only. Lowest algal nitrogen thresholds were: 0.06-0.08 mg NO_3-N/L; and 0.53-0.55 mg TN/L. Lowest algal phosphorus thresholds were: 0.02-0.06 mg PO_4^{-3}/L; and 0.06-0.10 mg TP/L. To prevent eutrophication (chlorophyll a ≥20 µg/L), models indicated that 92%, 78%, and [69%+50%] of samples should not exceed 0.08 mg NO_3-N/L, 0.02 mg PO_4^{-3}/L, and [0.08 mg NO_3-N/L+0.06 mg TP/L], respectively. Quantifying watershed-specific algal nutrient limitation and thresholds is critical to land managers, watershed managers, and other agencies in understanding the capacity of BMPs to meet eutrophication mitigation goals in lakes.

**Denotes primary author*

Multistate Financial Data for Use with the Agricultural Conservation Planning Framework (ACPF)

Track: Conservation Models, Tools, and Technologies

Time: 11:00 AM – 12:30 PM CT

Authors: *Emma Bravard (Iowa State University)*; John Tyndall (Iowa State University); Emily K Zimmerman (Iowa State University)*

The Agricultural Conservation Planning Framework (ACPF) is a GIS-based conservation planning tool that uses high-resolution elevation and water flow data to spatially identify critical source areas for nitrogen loss within agricultural watersheds. The ACPF allows users to explore different best management practice (BMP) opportunities and analyze potential nutrient loss reduction outcomes. We've developed (1) a multi-state financial data set; and (2) a field-scale nitrogen reduction tool for use when analyzing different conservation scenarios. This financial and expected field scale nitrogen loss data are used to calculate total long-term cost and cost effectiveness of various conservation plans. Financial data were created by calculating direct long-term annualized costs for BMP installation and management in the following states - Iowa, Minnesota, Illinois, and Indiana. Financial assessments were done with enterprise budgets and discounted cash flow techniques. The tool quantifies the nitrogen requirements for each field, based on 6-year land-use data, and evaluates the proportion of that nitrogen likely to be lost from the field via leaching as N load. Land use opportunity costs of BMPs that require removing cropped/pastured land from production are spatially determined according to state-relevant weighted-average crop productivity indices and land rent relationships. The combination of this data will assist water quality stakeholders and technical service providers determine where conservation practices should be placed on the landscape to yield the most effective and lowest cost Nitrate-N reduction at a watershed scale. These financial analyses that can be accomplished by using the ACPF are illustrated by case study watersheds in several Midwest states.

**Denotes primary author*

Farmer Advocates for Conservation: Farmer to Farmer Outreach

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Stephanie M Singer (The Nature Conservancy)**

The Farmer Advocates for Conservation program is training 60 farmers in the Maumee River Watershed to become technical experts and community leaders for sustainable agriculture. Each Farmer Advocate will use peer to peer methods to reach late/middle adopters with the result of at least 12,000 more farmers (200 farmers/Farmer Advocate) directly educated leading to adoption of best management practices to improve water quality. Farmer Advocates are paid to attend training and conduct outreach activities. A 36 hour curriculum has been developed to include: Engaging Across Differences in the Agriculture Community, Understanding your Audience, Preparing & Speaking to the Middle Adopter, Soil Health and Cover Crop Demonstrations, Soil Health Testing/Results, Economic Return in Investment, Water Management and Edge of Field Practices, Farm Leadership, Soil Health and Carbon Storage. Each Farmer Advocate is creating an outreach plan and Case study to share with their target audience. The Farmer Advocate for Conservation program is designed to elevate the good practices of innovative farmers and create peer to peer farmer networks working to implement conservation. This session will highlight the Farmer Advocate for Conservation farmer to farmer model and a Farmer Advocate will share their experience with the training and program.

**Denotes primary author*

Farmer Champions for Conservation Outreach

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Adam P. Reimer (National Wildlife Federation)**

Farmers are not only a key source of information for other farmers on conservation practices, but also serve as an important source of influence and social support for conservation adoption. Farmer-to-farmer outreach approaches to conservation outreach have been employed in a variety of contexts across North America. The National Wildlife Federation's Cover Crop Champions program supports peer-to-peer outreach through flexible outreach grants and training in effective outreach strategies to teams of farmers and conservation professionals. This program encourages innovative strategies to reach farmer audiences not typically engaged in conservation efforts and builds community resources through trainings and ongoing support. This talk will outline the Cover Crop Champions program approach, provide evidence on the effectiveness of the program to reach non-adopters, and highlight successful examples of innovative strategies employed by Champions teams.

**Denotes primary author*

Power of Soil: An Agenda for Change to Benefit Canada's Farmers and Climate Resilience

Track: Outreach, Education, and Community Engagement

Time: 11:00 AM – 12:30 PM CT

Authors: *Paul G.R. Smith (Equiterre and Greenbelt Foundation)*; Tom Bowers (Greenbelt Foundation); Alice Feuillet (Equiterre)*

Canada's governments have had policies for soil and water conservation for decades. But adoption of soil health practices remains modest. Canada spends far less on agri-environmental programs than the US and Europe and lacks the extensive social science and extension systems.

To promote significant change, Équiterre and the Greenbelt Foundation undertook to examine: (1) key soil health practices for Canada; (2) barriers to adoption of soil health practices; (3) existing climate and agri-environmental policy in Canada, and; (4) innovative policy approaches to increase soil health practice adoption.

The recommendations target Canada's new federal climate plan, and new Federal Provincial Territorial (FPT) agricultural policy framework, expected in 2023.

Prioritize Soil Health

- Make soil health a priority in FPT agricultural policy frameworks
- Collaborate on a National Soil Health Strategy
- Strengthen collaboration among government, farm groups, industry, and partners
- Integrate soil health initiatives in climate policies

Enhance Soil Health Learning

- Create a national 'Soil Health Network' for soil health knowledge
- Make the business case for soil health
- Provide support for key soil health practices
- Ensure soil health training for advisors and farmers
- Develop a national soil health check-up tool
- Build capacity for on-farm demonstration
- Enhance farmer-to-farmer learning opportunities
- Enhance public sector extension capacity
- National reporting on soil health

Incentivize Soil Health

- Increase overall funding for soil health
- Fund simple, low risk projects

- Reduce the risk of innovation
- Use offset protocols to fund soil health

Conserve Agricultural Land and Natural Areas

- Develop program to conserve vulnerable / degraded lands
- Reduce conversion of perennial forage lands to annual cropland

The recommendations would be a fundamental shift in direction in agri-environmental policy, while helping the long term viability of agriculture.

**Denotes primary author*

Dynamic Soil Properties of the Keith Soil Series in Northwest Kansas

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

Time: 11:00 AM – 12:30 PM CT

Authors: *Peter Tomlinson (Kansas State University)*; DeAnn Presley (Kansas State University); Savanna Crossman (Kansas State University); Laura Starr (Kansas State University); Catherine Stewart (Kansas State University)*

The Keith soil series (fine-silty, mixed, superactive, mesic Aridic Argiustolls), identified by NRCS as a benchmark soil series, covers a large extent of western Kansas with about 80% of the acres in cultivated cropland and 20% in native rangeland. The objective of this research was to compare dynamic soil properties of the Keith soil series under three management philosophies: native prairie remnants (Rangeland), conventional tillage (Conventional), and long-term no-till with either cover crops or a diverse crop rotation (Soil Health). Soil samples were collected in fall of 2018 at sites in Sheridan, Rawlins, and Thomas, counties in NW Kansas, to a depth of 1 m, and split by depths of 0-5 cm, 5-10 cm, 10cm to remainder of the A horizon, and then by genetic horizon. Samples were analyzed for the suite of physical, chemical, and biological properties. The focus of this presentation will be on near surface (A horizon) aggregate stability, soil organic C, respiration, permanganate oxidizable C, enzymes activities, and phospholipid fatty acid analysis (PLFA) results. The Soil Health and Rangeland pedons had greater percent aggregate stability than the Conventional pedon. The Conventional and Soil Health pedons were not statistically different for aggregate mean weight diameter, aggregate stability as determined by the single sieve method, soil organic C, total N, respiration, permanganate oxidizable C, enzymes associated with C, N, and P cycling, and PLFA results for total microbial biomass, AM fungi, gram negative and gram positive bacteria. The Rangeland pedon was numerically greater than the Conventional and Soil Health pedons in all cases and statistically greater than the Soil Health pedon. The similarity between the Conventional and Soil health pedons and the lower dynamic soil property values compared to the Rangeland pedon could be reflective of the legacy of cultivation compounded by the influence of the semiarid environment of western Kansas.

**Denotes primary author*

Microbial Taxa Associated with Reduced Tillage are Linked to Standardized Laboratory Respiration

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

Time: 11:00 AM – 12:30 PM CT

Authors: *Elizabeth L. Rieke (Soil Health Institute)*; Shannon Cappellazzi (Soil Health Institute); Michael Cope (Soil Health Institute); Daniel Liptzin (Soil Health Institute); Kelsey Greub (Soil Health Institute); Gregory MacFarland Bean (Soil Health Institute); Charlotte Norris (Soil Health Institute); Paul Tracy (Soil Health Institute); Cristine L.S. Morgan (Soil Health Institute); Wayne Honeycutt (Soil Health Institute)*

Over the past few decades numerous biologically based soil health measurements were designed to assess how agricultural management decisions affect soils' ability to function. Increases in measurements are commonly interpreted as greater measurement values indicate increases in soil health. However, increases in many measurements are difficult to interpret due to not being directly tied to ecosystems service functions. Standardized laboratory respiration measurements generally increase in systems managed for reduced tillage when compared to intensively tilled systems. However, in-field respiration measurements in are often driven by temperature and moisture, not management. Respiration bursts witnessed in standardized respiration measurements following the rewetting of sieved, air dried soil are a combination of microbial community members consuming cells lysed during drying, cytoplasmic substances released during rewetting, metabolic waste from new activity, and organic residues newly available from physical disruptions. In order to better understand drivers of standardized respiration measurements, soil microbial community response to tillage must be analyzed. Using data from the North American Project to Evaluate Soil Health Measurements, we analyzed bacterial and archaeal community response to tillage at nineteen sites across the United States, Canada, and Mexico using 16S rRNA amplicon sequencing. Reducing from intense tillage to minimum tillage on average shifted microbial community composition on average by seventeen percent. Furthermore, respiration measurements were modeled using random forest regression, with microbial community structure as independent variables. Microbial community members that were enriched under minimum tillage conditions were deemed important variables in the respiration random forest model.

**Denotes primary author*

Soil Health and Cotton Yield in Sandy Soil of the Semiarid High Plains of Texas

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

Time: 11:00 AM – 12:30 PM CT

Authors: *Katie Lewis (Texas A&M Agrilife)*; Joseph Burke (Texas A&M AgriLife Research); Paul De Laune (Texas A&M Agrilife)*

Analysis of soil health is common in modern soil research, but validation of soil health indicators in semi-arid cotton production regions is nearly nonexistent. A study was conducted at the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) and the Wellman Native Rangeland (NAT) to quantify NRCS proposed soil health metrics in cotton cropping systems. Treatments at the AG-CARES site included: (1) continuous cotton, winter fallow (CT), (2) continuous no-till cotton with rye cover (R-NT), and (3) continuous no-till cotton with mixed species cover (M-NT). The mixed species cover included hairy vetch (*Vicia villosa* Roth), Austrian winter field pea (*Pisum sativum* L.), rye (*Secale cereal*), and radish (*Raphanus sativus* L.). The AG-CARES study began in 1998 and the NAT site has never been plowed according to historical records. Soil samples were collected to a 100-cm depth on 31 May 2018 and 1 June 2018 for the NAT and AG-CARES locations, respectively. Indicators included soil organic carbon (SOC), permanganate oxidizable C (POxC), phospholipid fatty acids (PLFAs), β-glucosidase, and β-glucosaminidase. Results for all indicators were greatest at the 0-5 and 5-10 cm depths but decreased deeper in the soil profile. Conservation cropping systems (R-NT and M-NT) generally yielded greater SOC, POxC, and enzyme activities compared to the NAT and CT systems. These results indicate conservation cropping systems can provide greater soil health benefits compared to unplowed, native and conventional tillage systems on the Texas High Plains; however, cotton lint yield does not follow a similar trend.

**Denotes primary author*

Soil Health Parameters Vary Based on Soil Type in Semiarid Texas Cropping Systems

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

Time: 11:00 AM – 12:30 PM CT

Authors: *Joseph Burke (Texas A&M AgriLife Research)*; Katie Lewis (Texas A&M Agrilife); Christopher Cobos (Texas A&M AgriLife Research); Wayne Keeling (Texas A&M AgriLife Research); Paul De Laune (Texas A&M Agrilife)*

Conservation management practices, such as cover crops, no-tillage, and the Conservation Reserve Program, have significantly reduced wind erosion on the Texas High Plains since the Dust Bowl. The modern soil health movement has spurred additional interest in conservation adoption, but the soil health parameters are poorly understood and not calibrated for the region. The purpose of this study was to compare soil health measurements in different agricultural cropping systems within two of the most distributed soils in the region: Amarillo and Pullman series. The soil health parameters included in this presentation were soil organic carbon (SOC), permanganate oxidizable C (POxC), and β-glucosidase and β-glucosaminidase enzyme activities. These parameters were evaluated at two locations: the Agricultural Complex for Advanced Research and Extension Systems (AG-CARES) in Lamesa, Texas, USA (Amarillo fine sandy loam) and the Helms Research Farm, Halfway, Texas, USA (Pullman clay loam). The cropping systems replicated at each site included: (1) conventionally tilled continuous cotton, winter fallow (CC,CT); (2) no-tillage cotton-wheat-fallow rotation (C'20-W'21); and (3) no-tillage continuous cotton, cereal cover crop (CC,CC). Results demonstrated significantly greater SOC and POxC but not enzyme activities in the Pullman series compared to the Amarillo. Soil series had variable responses to cropping system with the greatest increases in soil health parameters between CC,CT and C'20-W'21 or CC,CC in the Amarillo series. Regional calibration of soil health parameters should include soil texture and varying cropping systems to maximize adoption.

**Denotes primary author*

Consistent Fertilizer Application Increased Corn Yields without Change in Nitrate Export

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: *Chelsea C. Clifford (Iowa State University)*; Matthew Helmers (Iowa State University)*

Iowa's corn yield rates have increased steadily over the decades, concurrently with application rates of nitrogen-based fertilizers. One might suppose that increases in yield required greater corn consumption of nitrogen, enabled through that fertilizer increase, and that that increased uptake would in turn reduce surplus nitrate drained into Iowa streams. However, experimental results from the Agricultural Drainage Water Research and Demonstration Site in Gilmore City, Iowa suggest otherwise. This experiment includes eight 0.05 ha plots in corn-soybean rotation, half in each crop each year, which we have fertilized at roughly the same rate for decades, 150 lb./ac. in 1990-1993 and since 2000, and 160 lb./ac. 1994-1999. While Iowa's corn yield has increased on average 2.50 bu./ac. per year from 1990 to 2020, these experimental plots have yielded an average of 2.16 bu./ac. more per year in that same time period, despite no concurrent increase in fertilizer. The slightly higher rate of increase observed statewide compared to in our plots is not statistically significantly different, and could as likely result from the subset of environmental conditions at our site as from differences in fertilizing. Meanwhile, the concentration and load of nitrate draining from our consistently fertilized plots has not significantly changed, only increased slightly, in those 31 years. The only substantial changes we've observed are higher loads in wetter years, with precipitation accounting for 39% of variation in nitrate loads. So, increases in corn yield alone did not decrease drainage nitrate export, even while controlling for effects of changes in fertilizer application rate. While spatially limited, this experiment suggests that increased corn yields observed in recent decades neither required increased fertilizer application nor reduced corn's contribution to aquatic nitrate excesses.

**Denotes primary author*

Economic Analysis of Controlled Drainage in Corn-Producing Farms in Quebec and Ontario

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: *Mfon Essien (McGill university)*; Chandra Madramootoo (McGill university)*

The need for efficient use of water resources in general and agriculture particularly is essential. The double burden of increased food demand and climate change has further intensified the demand for improved water management strategies. Agricultural water use has a significant impact on greenhouse gas (GHG) emissions therefore, developing and assessing beneficial water management practices that have the potential to mitigation GHG is vital. Controlled drainage (CD) is a water management practice that can be effective in reducing nitrate leaching (NO_3-N), nitrous oxide (N_2O) emissions, and improving crop yields on conventionally tile-drained agricultural lands. While existing studies reported that yields may not be significantly different between CD and TD however, the profitability of water management projects are yield sensitive. Thus, we evaluated the benefits and costs of implementing controlled drainage in corn-producing farms in two project sites; St. Emmanuel, Quebec and Harrow, Ontario. The study data used comprised of 12 years of crop yield data, 5 years of N_2O data and, 8 years of NO_3-N field data in Quebec, and 5 years of crop yield, N_2O and NO_3-N data in Ontario. We found that CD produced over 3% higher crop yields than TD on average. CD accounted for approximately 50% NO_3-N reduction, there was no significant difference between N_2O emissions from CD and TD in both project sites. Using benefit-cost analysis to determine the net present value, the results showed that CD produced a benefit due to yield of CAD 546 ha^{-1} (2015) and CAD 568 ha^{-1} at 5% over 20 years in Quebec and Ontario respectively. The impact of CD on reducing nitrate leaching can be estimated to equal approximately CAD 4 million annually. We conclude that controlled drainage is an “abatement agricultural technology” suitable for crop production systems in Quebec and Ontario, where soil and topographic conditions permit.

**Denotes primary author*

Lessons Learned from the Polk County Saturated Buffer Project: One Hit Wonder or Multiple Tours?

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: Keegan J. Kult (Ag Drainage Management Coalition)*

The Polk County Saturated Buffer Project formed a partnership in February of 2020 and created a framework to take the first serious effort to install conservation drainage practices at a significant pace. Project leadership utilized prior experiences to develop a framework they thought would give the project the highest likelihood of success. That framework included the following key elements:

- Prioritize watersheds for outreach that had a high occurrence of ACPF identified saturated buffer sites
- Incentivize participation by matching funding sources to provide 100% cost share plus a temporary construction easement
- Recruit landowners/farmers to install multiple sites instead of just a single site
- Rely on leadership to streamline the process for landowners
- Bundle the sites together for design and create multiple landowner bid-packages for contractors

Results to date have been encouraging as 50 plus sites are scheduled for construction in 2021. The 50 sites will nearly double the number of saturated buffers and bioreactors in the state. As part of the project, ADMC documented the process and evaluated the efficiency in order for others to replicate the project. This talk will walk through the cost effectiveness of a focused practice delivery system, the use of a fiscal agent model to replicate infrastructure improvement projects, as well as the use of the ACPF model to target outreach.

**Denotes primary author*

The Tradeoffs of Nitrogen-Loss Reduction Strategies in Agricultural Conservation Systems

Track: Water Resource Assessment and Management

Time: 11:00 AM – 12:30 PM CT

Authors: *Lindsay Pease (University of Minnesota Twin Cities)**

Many studies exist in the published record to evaluate the benefits of different agricultural nitrogen (N) best management practices (BMPs). Nevertheless, the potential for negative water quality outcomes following implementation is often less clear. The overall objective of this study was to synthesize published scientific literature on the potential water quality benefits of N BMPs and their associated tradeoffs. This synthesis focused on four in-field practices: fertilizer management, tillage, cover cropping, and integrated livestock management. The "tradeoffs" evaluated included: (1) the magnitude of difference between practices for N loss reduction; (2) efficacy compared to implementation cost (or cost per/lb of N reduced); and (3) changes to nutrient cycling that may still result in water quality degradation (e.g., increased erosion, increased dissolved phosphorus loss, N leaching to surface water instead of to groundwater). A comprehensive understanding of BMPs and their associated tradeoffs will aid in the development of systems approaches for watershed management. Ultimately, this will help to resolve water quality issues with fewer unintended consequences.

**Denotes primary author*

Adapting a Wetland to Benefit Local Conservation Needs

Track: Adapting Landscapes to Climate Change

Time: 1:00 PM - 2:30 PM CT

Authors: *Eugene A. Matzat**

Wetlands in a landscape can benefit a watershed both at its immediate location and downstream. Locally, wetlands provide a place to store water for recharge, filter water of nutrients and pollutants, and provide habitat for local and migrating wildlife. Given the increased frequency of large storm events, suggested by some due to climate change, wetlands provide temporary storage of rainfall from storm events, reduce stormflow and flooding downstream, and filter nutrients and sediments from the water.

A wetland restoration project on our property in rural St. Joseph County, IN, was undertaken for other purposes, but we have seen the traditional wetland benefits emerge after completion of the project. The area (about 5-6 acres) was a drained wetland with an old dug ditch running through it. Our concern with it was that the predominant plant growing across the wetland area was reed canarygrass (*Phalaris arundinacea*). We worked with NRCS, USF&WS and other agencies to develop a plan to control the reed canarygrass and provide wildlife benefits through wetland restoration. This presentation will describe the planning and implementation process for this wetland restoration project emphasizing the local resources used and the benefits already observed. Ideas will be shared that can easily be adopted by other private landowners to improve habitats for local wildlife and provide desired wetland benefits. One of the amazing results in the first year after wetland restoration was the nesting of sandhill cranes (*Antigone Canadensis*). Other observed benefits to the landscape will also be shared.

**Denotes primary author*

Bridging Scientific and Experiential Knowledges Via Participatory Climate Adaptation Research: A Case Study of Dry Farmers in Oregon

Track: Adapting Landscapes to Climate Change

Time: 1:00 PM - 2:30 PM CT

Authors: *Amy Garrett (Oregon State University)*; Melissa Parks (Oregon State University); Gabrielle Roesch-McNally (American Farmland Trust)*

In western Oregon's Willamette Valley, small fruit and vegetable growers have traditionally relied on irrigation to produce their crops but are increasingly experiencing water access issues due to precipitation pattern changes associated with climate change. In 2016, the Dry Farming Collaborative (DFC) was developed as a participatory model for facilitating research, social networks and resource-sharing among agricultural stakeholders to test the efficacy of dry farming as an adaptation strategy. Dry farming differs from irrigated cropping systems in that growers do not irrigate their fields and instead utilize a suite of practices to conserve soil moisture from winter rains for summer crop growth. To better understand how to meaningfully engage stakeholders in participatory climate adaptation research, this study explored how the participatory process facilitated the adoption of dry farming as a climate adaptation strategy among participants. Drawing on interviews with 20 DFC participants, including farmers, gardeners, and researchers, results indicate that the integration and use of different knowledge systems within the participatory research process made it easier for participants to integrate dry farming into their operational contexts. Processes designed to encourage interactions and information-sharing between participants and non-hierarchical researcher-grower relationships facilitated the exchange of these knowledge systems among participants, thus providing them with the trusted and salient information they needed to adopt new practices. These results indicate that these features could be useful for enacting future participatory climate research projects.

**Denotes primary author*

Farmer Climate Adaptation: Farming Harder, Farming Different and Stopping Altogether

Track: Adapting Landscapes to Climate Change

Time: 1:00 PM - 2:30 PM CT

Authors: *Robyn Wilson (Ohio State)*; Hugh Walpole (Ohio State); Mary Doidge (McGill)*

In the midwestern United States, climate change is expected to bring warmer temperatures, an overall increase in rainfall and more hydrological extremes. Changes in prevailing weather patterns will require farmers to adapt if they wish to continue to produce at current levels. While some adaptations to a changing climate are consistent with recommended best practices for soil and water conservation (e.g., planting winter cover crops), other adaptations are not (e.g., increasing fertilizer or pesticide use). This suggests that the adaptation decisions that famers make have repercussions not only for the resilience of the food system, but for the full breadth of ecosystem services provided by agricultural lands. Here we report on a survey of corn and soybean farmers from across five states in the eastern cornbelt of the United States. We assessed farmers current and future likely use of 19 possible adaptations to climate change. These adaptations ranged from adjusting current practices (e.g., growing more resilient varieties of crops already grown) to adding new practices (e.g., implementing winter cover crops) to leaving farming altogether (e.g., renting out one's land). We then investigated the interactive role of experiencing climate impacts, climate change beliefs, concern over changing weather patterns and farmer identities on adaptation in the three ways described above (i.e., farm harder, farm different, stop farming). These results have implications for how we expect farmers to adapt in the future, and how we may engage farmers to promote adaptation, and ultimately greater resilience in the agroecosystem. Specifically, if action is driven fundamentally by the experience of climate impacts, then we would expect greater adaptation in the future. We would also want to connect the experience of extreme weather events and concrete impacts in agriculture to the reality of future climate change, and the need for adaptation.

**Denotes primary author*

Forging the Missing Link: Conservation Services and Agricultural Cooperatives

Track: Adapting Landscapes to Climate Change

Time: 1:00 PM - 2:30 PM CT

Authors: *Joseph Otto (Soil and Water Conservation Society)**

This presentation will focus on an ongoing NRCS-funded project managed by the Soil & Water Conservation Society and carried out in partnership with Truterra and select Land O'Lakes member cooperatives in Nebraska, Kansas and Iowa. The three year project that began in 2020, was an inaugural recipient of NRCS's On-Farm Conservation Innovation Trials, a newly established component of the Conservation Innovation Grants program. Through the project, agricultural retailers are working with 57 growers on over 9,000 acres to run cover crop, zone nutrient management, and reduced tillage on-farm trials. The project's objective is to increase producer knowledge of these practices, integrate conservation management programs into retailer services, and broaden and accelerate conservation practice adoption. The underlying theme of this presentation and project is that agricultural cooperatives may represent a missing link in the proverbial chain linking publicly-funded conservation programming and the private agricultural lands that benefit. This presentation will provide a project overview and report preliminary survey results regarding retailers and growers' attitudes toward conservation practices and barriers to their adoption.

**Denotes primary author*

Ag Retail in Transition: Evaluating a Fee-Based Sustainability Service Model

Track: Conservation Economics and Policy

Time: 1:00 PM - 2:30 PM CT

Authors: *Seth Harden (The Nature Conservancy)**

TNC and The Center for Food and Agricultural Business at Purdue University are collaborating to develop fee-based services for ag retailers and accelerate adoption of conservation practices by farmers. A primary objective is to reduce reliance on product margins to maintain relevance in supporting needs of their farmer-customers. Purdue researchers conducted focus groups with staff of 5 ag retailers and customers. Inquiry was concentrated on business planning, conservation services, data management services, and current fee-based services. Another objective was to discover barriers ag retailers are facing in initializing and sustaining product and service offerings tied to conservation outcomes, including cover crops, nutrient management, and other agronomic prescriptions. Additional objectives included discovery of ag retailer training needs related to conservation. TNC and Purdue have determined knowledge gaps and new hypotheses for continued collaborative research. New phases of the research include a quantitative study as part of Purdue's Large Commercial Producer Survey, conducted every 5 years, and development of a business model framework supported by case studies of ag retailers who have successfully integrated environmentally focused services. TNC and Purdue researchers co-published a working paper in 2020. Results indicate a disparity between ag retailers and their customers on who should be initiating discussions of on-farm conservation, a lack of economic information to support conservation adoption, and how incentive design could optimize public-private partnership. A universal belief across ag retail and customers is that environmental sustainability will soon be a strategic element of farm and agribusiness. The presentation will also include preliminary results from the research initiated in 2021. Collaboration with agriculture retail, a distributed network of trusted advisers for farmers, is a promising endeavor for scaling conservation adoption.

**Denotes primary author*

Farmer Survey to Determine Perceived Benefits of Adopting Soil Health Practices for Corn and Soybean

Track: Conservation Economics and Policy

Time: 1:00 PM - 2:30 PM CT

Authors: *Archie Flanders (Soil Health Institute)**

Management practices like no-till and cover cropping that improve soil health can be good for both farmers and the environment. However, farmers need better information on the potential agronomic and economic benefits of adopting soil health management systems (SHMS) before deciding whether to invest in these practices.

To obtain this information the Soil Health Institute conducted farmer interviews in 2019 and 2020 with a total of 100 farmers in nine states in the major corn and soybean producing regions of the U.S. All farmers were adopters of SHMS and willing to share their production practices associated with adopting soil SHMS.

The 100 farmers interviewed grew crops on an average of 1942 acres, using no-till on 85% and cover crops on 55% of those acres. Many of the farmers also implemented nutrient management practices such as grid soil sampling (86%), variable rate fertilizer application (82%), and split application of nitrogen (89%) as part of their overall soil health management system. As a result of adopting these various SHMS, 67% of these farmers reported increased yields, 81% indicated reduced fertilizer use, 97% reported increased resilience to extreme weather, and 93% indicated increased access to their fields as examples of agronomic benefits. The current adoption rates of no-till (37%) and cover crops (5%) in the U.S. indicates that other farmers in the U.S. could receive similar benefits by adopting soil health management systems.

**Denotes primary author*

Corn and Soybean Economic Analysis for Soil Health Management Systems

Track: Conservation Economics and Policy

Time: 1:00 PM - 2:30 PM CT

Authors: *Archie Flanders (Soil Health Institute)*; Cristine Morgan (Soil Health Institute); Wayne Honeycutt (Soil Health Institute)*

Reduced tillage and incorporating cover crops in corn and soybean production can decrease soil erosion, improve water infiltration, increase soil carbon, and reduce inputs that can create negative environmental externalities. Public policies that promote adoption of agricultural practices that improve soil health would be better informed by a quantitative understanding of how these practices affect individual farm profitability. Farmers continue many production activities of a conventional farming system when adopting a Soil Health Management System (SHMS), and implementation of a SHMS involves changes in a select few production activities. Hence a partial budget analyses is a simple methodology for quantitatively documenting how a SHMS effects on farm profitability. Partial budget analysis is an analytical method in which comparative financial returns are determined by quantifying the net effect of only the changes in an agricultural production system. A partial budget methodology will be used to demonstrate procedures for quantifying changes in production costs associated with adoption of SHMS. In 2019 and 2020, the Soil Health Institute collected and analyzed interview data from farmers who had adopted SHMS. The farmers interviewed were from nine states that comprise the major region for U.S. corn and soybean production. Results of the partial budget analysis demonstrate reduced farm production expenses due to adoption of SHMS. Yield increases that are attributable to SHMS increase revenue and net farm income increases for corn and soybean support expanded adoption of production practices to increase soil health.

**Denotes primary author*

Rotational Grazing Management Practices: An Assessment of Economic and Environmental Outcomes and Explanations for Low Adoption Rates

Track: Conservation Economics and Policy

Time: 1:00 PM - 2:30 PM CT

Authors: *David Hennessy (Michigan State University); Hongli Feng (hfeng)*; Srinivasulu Ale (Texas A&M AgriLife Research); Urs Kreuter (Texas A&M University); Richard Teague (Texas A&M AgriLife Research); Tong Wang (South Dakota State University)*

Rapid conversion of grassland to cropland in the Great Plains has caused many adverse environmental consequences. Even on existing pasture and rangeland, conventional grazing practices have caused rangeland degradation and reduced ecosystem resilience. To avoid grassland conversion and maintain sustainable livestock production, it is essential to identify management practices that simultaneously promote economic profit and environmental quality. Rotational grazing, including management intensive grazing (MIG), mimics the native grazing ecosystem in which regular moving of large herbivores allows grazed grass sufficient time to regrow. The average adoption rate of RG among ranchers is just over 30 percent in the US, which is low and puzzling given the apparent benefits of RG as evidenced by empirical research and various efforts aimed at promoting adoption.

Research is needed to determine whether RG is economically viable and environmentally sustainable and how policies can promote adoption. Our project is aimed to address these questions. We assessed short- and long-term profitability of RG for different cattle production phases with budgeting and dynamic modeling approach. SWAT models are used to evaluate the environmental impacts of RG at ranch and watershed scales under different climatic, soil and topographic conditions. We conducted a survey of ranchers in the Dakotas and Texas to explore the link between RG adoption and land use conversion and inquired into perceptional factors that inhibit RG adoption. Our modeling and simulation results show that RG can lead to “win-win” outcomes, i.e., positive economic and environmental outcomes and most survey respondents also viewed RG as “win-win”. The decision maker’s circumstances are important for the non-adoption of a “win-win” practice. Further research is needed to investigate whether modeled and perceived “win-win” is in fact “win-win” and how policies can help given individual circumstances.

**Denotes primary author*

A Decision-Support Tool to Design Subsurface Drainage Systems for Water-Quality Protection

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

Authors: *Ehsan Ghane (Michigan State University)**

Agricultural subsurface drainage is critical for crop production in temperate humid regions. With the heightened concern of its water-quality implications, we need a method to design drainage systems for both crop production and water-quality protection. When practitioners choose a drain spacing that is too narrow for a specific field, more nitrate is lost. The objective of this study is to develop a user-friendly decision-support tool to design subsurface drainage systems for crop production and water-quality protection. The tool estimates the optimum drain spacing that maximizes economic return on investment in the drainage system. The tool provides water-quality benefits in two forms. First, it helps avoid using too narrow of drain spacings. When drain spacing is narrower than necessary, more water is drained, and thereby nitrate loss increase. The second water-quality benefit is that the tool estimates drainage discharge of any user-specified drain depth. Consequently, the user can evaluate the drainage discharge reduction of the drainage conservation practice of shallow drains when compared to deep drains. Nitrate load reduction has been shown to be mainly due to reduction in drainage discharge. Therefore, the estimate of drainage discharge can provide insight into how shallow drains reduce nitrate load. This oral presentation will include a brief background of how the tool works. Most of the presentation will be focused on demonstration of the tool features and how it can be used to protect water quality.

**Denotes primary author*

Building Trust While Understanding Complexity: Process Models for Edge-of-Field Practices

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

Authors: *Catherine R. DeLong (Past Soil and Water Conservation Society, Iowa State University Extension and Outreach)**

Implementation of edge of field practices like wetlands, saturated buffers and bioreactors are complicated by several factors. These practices require the coordination of multiple personnel including the farmer, landowner, engineer, construction contractor, funding entity and the conservation professional who often acts as the liaison between all stakeholders. Additionally, in the case of wetlands implementation can take multiple years due to shifting funding sources and multiple alterations to engineering designs depending on site limitations. To build trust with the farmer and landowner, it is necessary for the conservation professional to convey the complexity and timeframe of the project, while also assuring them that there is a plan and an orderly process for its completion. For that reason the Soil and Water Conservation Society (SWCS) worked with the Iowa Department of Agriculture and Land Stewardship and the Agricultural Drainage Management Coalition to create process models for the implementation of wetlands, saturated buffers and bioreactors. A process model is a visualization of time, labor and other resources that go into a particular process and is a useful tool for the farmer/landowner as well as the stakeholders engaged in implementation. In this presentation SWCS will share the Iowa-based process models, bottlenecks and opportunities for efficiencies from the analysis of alternative state models, and recommendations for the future.

**Denotes primary author*

Driving Decisions with Data: Using an Interactive Interface to Predict Conservation Practice Effectiveness

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

Authors: *Sarah Blount (American Farmland Trust)*; David Kennewell (Hydrata); Jeff Boeckler (Northwater Consulting)*

When working with farmers, delivering fast and simple answers to complex questions is incredibly important. Programs like ArcMAP are great for data aggregation and analysis but not for creating quick, readable results. American Farmland Trust created an interactive online interface for the Upper Macoupin Creek Watershed (UMC) project area that provides in-field and real-time evaluation of potential conservation practices to give farmers and conservation professionals insights into the most effective options. The interface integrates existing ArcMAP layers and a Spatial Watershed Assessment and Management Model (SWAMM) to identify priority areas and to estimate load reductions based on practice scenarios. When discussing practices with farmers to reduce phosphorus, nitrogen, and sediment losses from their farms, a conservation technician can simply draw the practice (e.g. cover crops, grassed waterways, reduced tillage, etc.) into the interface and receive immediate reduction estimates. Not only does the interface show predicted reductions for one farm at the time but implemented practices can be saved to the interface and corresponding reduction data aggregated to show progress towards overall watershed goals. Initial engagement with farmers has been positive, and the interface and the data it provides will help the UMC reach its reduction goals by simplifying one-on-one outreach with farmers and easily tracking reductions as they occur.

**Denotes primary author*

Integrating the Agricultural Conservation Planning Framework into Watershed-Scale Conservation Planning: Guidance for the NRCS and Conservation Partners

Track: Conservation Models, Tools, and Technologies

Time: 1:00 PM - 2:30 PM CT

Authors: *Emily M. Usher (Purdue University)*; Hanna Bates (Iowa Water Center/Iowa State University); Pranay Ranjan (Purdue University); Michelle Hemler (Purdue University); Emily K. Zimmerman (Iowa State University); Chris Morris (Iowa State University); Linda Prokopy (Purdue University); John Tyndall (Iowa State University)*

The Agricultural Conservation Planning Framework (ACPF) is a flexible, user-friendly, and widely applicable conservation planning tool developed in partnership with the USDA Agricultural Research Service and the Natural Resources Conservation Service (NRCS). ACPF's non-prescriptive approach uses geospatial data and an ArcGIS-based toolbox to identify site-specific conservation opportunities that address on-farm and community-wide resource concerns. While the ACPF supports watershed-scale planning efforts, introducing a new decision-support tool to NRCS' conservation planning workflow presents organizational, technical, and social challenges. Using a mixed-methods approach, we conducted in-depth interviews and surveys with NRCS staff that focused on technical, social, and institutional aspects of the ACPF. The resulting implementation guide highlights challenges and opportunities for ACPF, guides ACPF messaging and training, and identifies key roles for stakeholder support of APCF at local and regional scales. The framework we propose in this implementation guide supports ACPF's integration into NRCS conservation planning efforts and provides guidance to stakeholders broadly interested in using decision-support tools for watershed-scale conservation planning.

**Denotes primary author*

Nonoperator Landowner vs. Tenant Perspectives on Agrienvironmental Issues and Landlord-Tenant Relationships

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Derek Franklin (Iowa State University)*; J.G. Arbuckle (Iowa State University)*

Roughly half of the cropland in the US Corn Belt is rented. Given this magnitude of rented land in the US agriculture system, surprisingly little research has examined the relationships between renters and landlords, and how those relationships might influence social and environmental outcomes. Prior research has suggested that rented farmland may receive less conservation efforts that could help to alleviate environmental problems associated with agriculture. We analyzed results from a 2017 survey that collected data from non-operator landowners (NOLs) and tenant operators in the two counties with the highest percentages of rented land in Iowa and Ohio, respectively. Questions focused on their environmental awareness and concerns related to agriculture and their beliefs regarding what characteristics are desirable in good tenants and good landlords. A better understanding of how NOLs and farmers align and misalign on these issues may result in better-informed conservation outreach toward the owners and managers of rented farmland.

Findings indicate significant differences between the perspectives of non-operating landowners and renters regarding the importance of productivist and stewardship values, responsibility for soil and water conservation, and roles in decision-making, but the groups aligned in their emphasis on trust, the importance of soil and nutrient management, and qualities of a good renter. The results suggest that NOLs care more about land stewardship than commonly assumed. Overall the results point to areas of common ground on which NOL-tenant conservation partnerships could be promoted, as well as differences in perspectives that outreach programs might address.

**Denotes primary author*

Perspectives on Nutrient Management Planning: Survey of Soil and Water Conservation Staff in Upper Mississippi River Basin States

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Kelly Shen (Duke University)*; Adena Rissman (University of Wisconsin - Madison); Chloe Wardropper (University of Idaho)*

Nutrient and soil loss in the Upper Mississippi River Basin contribute to polluted drinking water and blue-green algae blooms that impact recreation, tourism, and agricultural productivity. Nutrient management planning (NMP) is a practice that seeks to optimize fertilizer use and minimize nutrient loss from farms. It is recommended or required across most states, and is a cornerstone of non-point pollution reduction plans, such as those under the Gulf Hypoxia Taskforce. However, NMP implementation is not well documented or tracked. In this study, we asked soil and water conservation district staff to identify knowledge gaps and needs in nutrient management planning. 277 representatives of soil and water conservation departments (or districts) responded to our survey in 2016 from seven states: Illinois, Indiana, Iowa, Minnesota, Missouri, Ohio, and Wisconsin. The survey had a 43% response rate. Although nutrient management planning was, on average, a moderate to high priority for respondent districts and departments, 32% of all respondents indicated that they do not know the percentage of agricultural land in their county with an up-to-date nutrient management plan. Of respondents who could estimate, most believed that only between 10% and 20% of agricultural land in their county has an up-to-date nutrient management plan. Furthermore, of conservationists who review plans, 26% were not at all to slightly confident, 58% were somewhat confident, and 16% were very to extremely confident that nutrient management plans are followed. The largest perceived barriers to implementing nutrient management plans were a lack of farmer buy-in and lack of ability to enforce plan implementation. Respondents indicated that increased farmer involvement, resources, and targeting would assist with improving nutrient management in the counties where they work, underlining the need for inclusive stakeholder engagement in NMP implementation.

**Denotes primary author*

Promoting Conservation on Rented Farmland: Unraveling Information Networks and Messages for Non-Operating Landowners

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Pranay Ranjan (Purdue University)*; Mazie Bernard (Purdue University); Seth Harden (The Nature Conservancy); Hans Schmitz (Purdue Extension); Linda Prokopy (Purdue University)*

Promoting conservation behavior on rented farmland could improve soil health, water quality, and land values in the Midwest and nationwide. However, the successful promotion of conservation on rented farmland is constrained due to significant gaps in our understanding of who communicates with non-operating landowners (NOLs), and what this communication pertains to. Substantive research on motivations for farmers, i.e., those who own and operate their land, to adopt conservation practices highlights the role of information seeking networks, including farmers' connectedness and interactions with conservation agencies, local farmers, and watershed groups. Advances in understanding the importance of farmer networks, including the crucial role of "intermediaries" in motivating conservation behavior, however, has not translated into a systematic examination of actors who communicate with NOLs, and how, if at all, they frame conservation messages. We address this knowledge gap by conducting an online survey of individuals who act as information sources for NOLs across Indiana. Our findings reveal the types of NOLs actors engage with, modes of engagement, the types of services rendered, messages used to promote conservation behavior, among others. Our findings provide useful information for Extension and other non-profit organizations working with NOLs and tenant farmers.

**Denotes primary author*

The Conservation Practitioner Poll: An Annual Survey to Help Improve Conservation Engagement

Track: Social Sciences Informing Conservation

Time: 1:00 PM - 2:30 PM CT

Authors: *Clare L. Lindahl (Soil and Water Conservation Society); J.G. Arbuckle (Iowa State University)*; Chris Morris (Iowa State University)*

Conservation practitioners work hand-in-hand with farmers to put conservation practices on the ground: they are the delivery system for conservation across the nation. They provide technical assistance, target and implement funding, work with farmers to understand their land and resource concerns, and translate farmers' long-term goals to the landscape. And yet, the voice of conservation practitioners is almost completely absent from policy discussions. In 2020 and 2021, the Soil and Water Conservation Society and Iowa State University initiated the Conservation Practitioner Poll (CPP), a survey that will regularly collect data on the needs and recommendations of conservation practitioners. The survey will provide research-based infrastructure to facilitate understanding and communication of conservation practitioners' perspectives on an ongoing basis. The first CPP survey was conducted in spring 2021. Questions were developed based on findings from focus groups with conservation practitioners from NRCS, soil and water conservation districts, watershed groups, and other conservation organizations and consultation with other key personnel from these organizations. Survey questions examined conservation practitioners' perspectives on topics such as the effectiveness of major conservation programs, preferred farmer/landowner engagement approaches, organizational strengths and weaknesses, and thoughts about what they might need to help them in their work with farmers and landowners. This presentation will summarize major findings from both the survey and the focus group data.

**Denotes primary author*

Impact of Cover Crop Seeding Rate and Soil Type on Biomass and Weed Suppression

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Donna S. Gentry (LSU AgCenter)*; Lisa M. Fultz (LSU AgCenter)*

The integration of winter annual cover crops into a cropping system can potentially improve soil health and production, however, the impact of variables such as seeding rates, across two very different soil types, has not been well documented. A two-year study was conducted at the Dean Lee Research Station and Extension Center in Alexandria, Louisiana to evaluate the effects of seeding rate and soil type on cover crop growth and biomass, in addition to weed suppression in a soybean (*Glycine max*) production system. Three broadcast seeding rates of tillage radish (*Raphanus sativus* var. L), cereal rye (*Secale cereal*), and crimson clover (*Trifolium incarnatum*) were planted into Moreland clay and Coushatta silt loam soils in the fall of each year and chemically terminated six weeks prior to soybean planting. Biomass samples were collected immediately prior to termination where cover crops and weeds were separated, dried, and weighed. Nutritive analysis was also performed on biomass. Results indicated seeding rate affected cover crop biomass with low rates of radish being greater than high rates (1,812 and 807 kg ha^{-1}, respectively) but was not different for cereal rye or crimson clover. Biomass was 61% greater in year 1 versus year 2 , while weed biomass increased 24% during that same time. Weed biomass for all rates of cereal rye and low and medium rates of tillage radish was lower (ranging from 18-323 kg ha^{-1}) compared with all seeding rates of crimson clover. Soil type had no effect on cover crop biomass or weed suppression for this study which indicates environmental conditions and specific species may have greater influence on biomass production.

**Denotes primary author*

Impacts of One-Time Tillage Compared to No-Tillage on Soil Health in a Diverse Rotational Cropping System

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Devyn McPheeters (The Pennsylvania State University)*; Heather Karsten (The Pennsylvania State University); Mary Ann V. Bruns (Penn State University)*

Soil health refers to a soils' ability to sustain biological life into the future while maintaining water and air quality. No-till agriculture is a strategy often used to improve soil health and growers show concern about the effects of any physical disturbance on the health of their soil. This study aimed to answer the question: Can soil health indicators be used to assess impact of one-time tillage events? This question was approached using three soil health indicators, aggregate stability, labile carbon, and total carbon, to determine the impacts of tillage once in a six-year crop rotation on soil health. We studied soil in the Pennsylvania State Dairy Cropping Systems project in Rock Springs, PA, that was initiated in 2010 as a full crop entry experiment, with the 6 phases of the crop rotation planted every year in a randomized complete block design, replicated four times. Crop phases were the main plot and weed control treatments were split-plots. Soil was sampled in spring 2010 prior to the start of the experiment and in 2013 and 2016 at two depths: 0-5 and 5-15 cm for labile and total carbon and to 15 cm for aggregate stability. The cropping system features cover crops and perennials and compares one-time tillage as a strategy for herbicide reduction to no-tillage with standard herbicide application. By the end of the six-year rotation, plots that received one-time tillage had recovered to the same soil health levels as the no-till plots in all three indicators, but only after three years of perennial cover. Plots that had not had perennial cover since the tillage event or had only been under perennial cover for one or two years, had significantly lower soil health indicator scores than the no-till plots. Results from this analysis indicate that soil health can return to no-till levels despite a tillage event if they receive adequate perennial crop cover.

**Denotes primary author*

Microbial Community Dynamics and Functional Gene Diversity in Plots Managed with Cover Crops and No-Till Farming in the Mississippi Alluvial Valley

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Alexandra G. Firth (Mississippi State University)*; Beth H. Baker (Mississippi State University); John Brooks (USDA-ARS); Martin Locke (USDA-ARS); Ashli Brown (Mississippi State University); Dana Morin (Mississippi State University)*

Agriculture is the greatest contributor to overall consumptive water use with deleterious effects seen in river depletion and groundwater over draft. Despite negative documented effects of agricultural production practices (i.e. soil erosion, compaction, nutrient runoff) on critical natural resources (i.e. water), food production must increase to meet the demands of a rising human population. There is a growing interest in conservation practices that improve soil health and ecosystem services while mitigating the negative effects of crop production. Soil biological activity is an important pillar of soil health. Although available scientific literature on the positive impact conservation can have on soil microbial populations is extensive, it is generally specific to the midwest and northeast United States. In the Mississippi Alluvial Valley (MAV) region of Mississippi, USA, the adoption of cover crop (CC) and no-till (NT) management has been low because of a lack of research specific to the region. Therefore, the purpose of this study is to assess the microbial community changes and activity levels in soybean (Glycine max) crop fields following CC implementation. Treatments were analyzed for differences in bacterial community composition (16S rRNA libraries), enzyme activity and functional gene diversity (quantitative PCR) during the growing season. Generalized linear mixed models (GLMM) were used to assess the effects of tillage, CC and time effect soil microbial community response (community composition, enzyme activity, alpha diversity, functional gene abundance). It is predicted that the combination of CC and NT treatments will increase microbial community diversity and activity. This study is expected to provide valuable information related to CC impact on soil microbial community dynamics for conservation and agricultural advisors and producers in the mid-south.

**Denotes primary author*

Soil Microarthropod and Entomopathegenic Nematode Diversity in Native Grass and Wildflower Meadow Trial Plots in the Hudson Valley, New York

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

Time: 1:00 PM - 2:30 PM CT

Authors: *Jessica Furlong (SUNY Cobleskill)*; Emily Krsnak (SUNY Cobleskill); John Pipino (SUNY Cobleskill); Carmen Greenwood (SUNY Cobleskill)*

Soil provides habitat for a variety of organisms which assist numerous ecosystem services including nutrient cycling, organic matter (OM) decomposition, and pest suppression. Microarthropods, specifically oribatid mites, are sensitive to changes in soil quality, positively affiliated with OM, and often used as soil health indicators. Entomopathogenic nematodes (EPN) in soils, and the bacteria they carry, can naturally act or be cultivated for commercial use as biological control agents. Our study examined microarthropod abundance, diversity, community composition, and oribatid and EPN prevalence at fields transitioned from agricultural production. Composite soil samples were collected from three Native Meadow Trial (NMT) plots each with subplot cover treatments grown from seed mixes dominant in native wildflowers, native grasses, hay, or fallow land located at Hudson Valley Farm Hub in Hurley, NY during June, July and August of 2020. Tullgren funnel extraction collectively yielded a total of 2,182 organisms representing 46 different taxa; 20 of these taxa were mites, with 9 representing oribatid mites. Overall, hay yielded highest OM and microarthropod abundance. Wildflower and hay were highest in mean taxa richness and Shannon's diversity. Soil moisture content was highest in native grass and fallow treatments. When OM was compared to oribatid mite prevalence, linear relationships were negative in hay and fallow, and positive in wildflower and grass treatments. Different soil types in plots may have influenced results. Bioassays of June samples detected two EPN species. The EPN S. carpocapsae was more prevalent than S. feltiae across all soil types and field cover types, with the exception of wildflower. Ultimately, this work is part of a larger study comparing the biodiversity of multiple communities within the NMT to develop regional guidance for growers seeking to increase beneficial insect, bird, and other wildlife biodiversity through farmscape ecology systems.

**Denotes primary author*

Applying Farmer Identity Social Science Research to Encourage the Adoption of Ag Tile-Treatment Wetlands to Reduce Nutrient Loss

Track: Conservation Economics and Policy/Social Sciences Informing Conservation

Time: 3:00 PM - 4:30 PM CT

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

In the 20th century, a high-input/high-output system of agriculture developed in the Upper Midwest. Two aspects of this system—the application of nitrogen fertilizer and the extensive use of subsurface drainage systems—have resulted in high nitrate levels in creeks, ditches, and rivers. The impact has been devastating to water quality in the Mississippi River Basin and the Gulf of Mexico.

In Illinois, a suite of in-field and edge-of-field conservation practices are being used to address the agricultural nutrient loss problem. One method --tile-treatment wetlands -- is a practical, long-term solution for reducing nitrate loss from ag subsurface drainage systems. Treatment wetlands are widely used in municipal and industrial wastewater treatment and are considered an effective and efficient way to breakdown nitrates. The Wetlands Initiative has developed the Smart Wetlands (SW) program to work with row crop landowners/operators to reduce nutrient loss in support of the Illinois Nutrient Loss Reduction Strategy.

This tile-treatment practice is currently in use on only a handful of farms in Illinois and is relatively unknown to the state's farmers, landowners, and agribusiness professionals. Moreover, a significant majority of the state's farmers likely view wetlands as a source of croplands and not vice versa. When this view is combined with the high-upfront cost, the long-term commitment, and the risk their neighbors will regard them as bad farmers, SW are hard to sell.

To overcome these challenges to adoption, the SW team uses the sociological framework known as the "good farmer identity" (GFI). This presentation will provide a short overview of this concept and share the specific ways we have used GFI to foster relationships, establish partnerships, and develop other outreach approaches to motivate farmers and landowners to consider installing a Smart Wetland on their land.

**Denotes primary author*

Creating Opportunities for Climate Resilient Agriculture by Optimizing Federal Crop Insurance

Track: Conservation Economics and Policy/Social Sciences Informing Conservation

Time: 3:00 PM - 4:30 PM CT

Authors: *Laura K. van der Pol (Colorado State University)*; Dani Lin Hunter (Colorado State University); Clara Tibbetts (Colorado State University)*

Climate change is devastating global agricultural and economic systems and has already caused reduced yields and increased farm-support through crop insurance. Nature-based solutions that promote conservation agriculture can address these challenges while mitigating the negative effects of climate change. Several aspects the crop insurance system disincentivize adaptation to climate change and reduce resiliency of food systems around the world. We propose a pilot crop insurance and research program in the U.S. Northern Plains to promote practices that enhance soil health, farm income, resilience, and climate change mitigation to inform nationwide adoption of such practices. We propose a 3-pillar approach: (1) eliminate insurance requirements for fallow to expand annual cropping which has been shown to promote soil health and increased income; (2) fund development of regionally-adapted leguminous crops that promote soil health and local economies; (3) modify the whole farm insurance program to insure farm income rather than single-crop yield and create a system that values diverse rotations and soil health. Combined these policy actions would incentivize conservation agricultural over short- and long-term scales, reduce greenhouse gas emissions, and improve agricultural and economic resiliency to the threats posed by climate change.

**Denotes primary author*

Past and Future Local Weather: Farmers' Perceptions and Their Roles in Land Use Decision

Track: Conservation Economics and Policy/Social Sciences Informing Conservation

Time: 3:00 PM - 4:30 PM CT

Authors: *Hongli Feng*; Gaurav Arora (IIIT Delhi); David Hennessy (Michigan State University)*

Weather is a critical factor for agricultural production. How growers perceive weather and changes in weather trends will determine land use and other agricultural production practices in a region. This study presents a spatial-temporal analysis of localized weather perceptions of growers from a Farm Survey in eastern North and South Dakota. Past (2004 to 2014) and future (2014 to 2024) perceptions of four indictors were studied: temperature, precipitation, drought frequency and flood frequency. We found that weather perceptions exhibit positive spatial autocorrelation and respondents with similar beliefs are located in localized clusters. About half of the respondents perceived temperature as being the same as the last 10 years and staying about the same in the next 10 years. Consistent with scientific projections of climate change trends in the region, more respondents perceived that the climate would change from being cooler and wetter to warmer and dryer rather than the other way around in the future 10 years.

Many farmers perceived local weather to be cyclical in the sense that cooler weather will be followed by warmer weather and vice versa. For example, among those who perceived that weather became cooler over the past decade, only 11% believed that weather would be cooler in the future decade. Policy implications would be very different for farmers who perceive weather changes as part of cyclical patterns from those who perceive these changes as trends towards higher temperature, lower precipitation, less floods and more frequent droughts. Importantly, farmers who view weather patterns as inherently cyclical might resist mitigation/adaptation policies that target global warming trends and ignore hot and cold weather cycles.

We link land use changes with changes in weather to find that regression-based inference would differ depending upon whether actual weather data or perceived weather are included as regressors.

**Denotes primary author*

Wetlands Protection and Planning: What Do Experts Say Constitutes "Good" Decision Making?

Track: Conservation Economics and Policy/Social Sciences Informing Conservation

Time: 3:00 PM - 4:30 PM CT

Authors: *Sarah Church (Montana State University)*; William Kleindl (Montana State University); Ashlie Gilbert (Montana State University)*

Since the early 1990s, Federal policy has required a no overall net loss (NNL) of wetland area, functions, and values in the United States (US) and has incorporated that initiative into compensatory mitigation guidance. Past efforts to mitigate for permitted wetland loss has focused primarily on wetland structure and function and less on inherent ecosystem services (ES). Because of these unexamined management choices, there is a potential for disconnect between where wetlands are lost and where they are mitigated that changes access to these wetland ecosystem services by the community beneficiaries. This disconnect can lead to a loss of ES that are valued by the communities. As the Western US continues to grow at a rapid rate, this loss is contentiously increasing. Through this research, we seek to understand how policy and planning changes might positively influence wetland protection. We administered an online survey to aquatic systems experts in several western states (MT, ID, WA, CO, SD) (n=179). We report on results of a series of questions that asked aquatic systems experts to rate how important different components of wetland protection are, including public access, public and wetland-decision makers' understanding of wetland ecosystem services, collaborative planning processes, communication between different scales of government agencies, federal and state polices, and local government land-use decisions and processes. We also report on respondents' attitudes toward the importance of which wetlands should be protected and where mitigated wetlands should be located, ranging from purely biophysical components to considerations of public access. We expect that these results will be of interest to natural resource managers, wetland mitigation decision makers, and local governments who must manage aquatic resources in a way that protects wetland ES and mitigates conflict between different aquatic system stakeholder groups.

**Denotes primary author*

Interactive Simulator to Quantify Economic, Environmental and Societal Benefits of Cover Crops

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *Suzanne Fey (Iowa Soybean Association); Peter Kyveryga (Iowa Soybean Association)**

Cover crops have the potential to be a financial asset when managed well in long-term. The online “Cover Crop Economic Simulator” will help to illuminate which management strategies will make them pay in your operation. The tool is designed for farmers, landlords as well as the general public interested in measuring the environmental and economic outcomes of cover crops.

Based on partial budget economic analyses of cover crops, this unique, interactive simulator shows visual illustrations of estimated outcomes based on a range of market prices and provides examples of cost offset opportunities and their impact on revenue, creating a sensitivity analysis of net return.

This tool provides an easy starting point for those unfamiliar with cover crop management, as well as a useful platform for long-time cover crop beneficiaries. All formulas can be viewed, and input values edited and results automatically recalculated. Revenue sources have quick-select options to offset base costs, which can also be tweaked to reflect the specific programs available in your area.

Beyond farm revenue and land value increase, we also want to raise awareness of the societal benefits you and your community will reap from cover crops. Some of these things are more difficult to tie directly to your bottom line in dollars and cents, but their value is no less real, tangible, or meaningful.

**Denotes primary author*

Nitrogen Losses in Response to Conservation Practices and Sustainable Intensification in a Corn-Soybean Cropping System

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *Bryan Emmett (USDA-ARS)*; Peter O'Brien (USDA-ARS); John Kovar (USDA-ARS); Robert Malone (USDA-ARS); Dan Jaynes (USDA-ARS); Tim Parkin (USDA-ARS); Keith Kohler (USDA-ARS); Tom Moorman (USDA-ARS)*

Nutrient losses in subsurface drainage water and gaseous losses of nitrous oxide (N2O) reduce nutrient use efficiency and create unwanted environmental impacts. Management of nutrients and cropping systems offers potential for mitigating these losses. We compared four different cropping systems with respect to nitrogen (N) losses at a field site in central Iowa. All cropping systems included corn and soybeans grown in alternate years. Treatments included (1) a 'business as usual' treatment consisting of an early spring-applied fixed N rate (200 kg ha^{-1} in corn years). The tillage system involved fall chisel plowing of corn residue, followed by spring disk and field cultivation (seedbed preparation) prior to planting each crop, (2) N applied in late spring according to the Late Spring Nitrate Test (LSNT) with no-tillage; (3) N applied in late spring according to the LSNT with no-tillage and rye cover crops preceding corn and soybean; (4) N applied in late spring according to LSNT with mixed cover crops preceding corn and a winter camelina relay-crop preceding soybean. No N was applied to soybeans (2017 and 2019), but 67 kg N ha^{-1} was applied to camelina. Each treatment was replicated in four 0.13 ha plots that had individual subsurface tile drains equipped to monitor flow and provide samples for nutrient analysis. N_2O emissions were measured in each plot using static chambers sampled weekly from spring thaw to harvest and biweekly until winter freeze. Both rye and camelina reduced nitrate loss in subsurface drainage compared to the business as usual treatment, but the rye was more effective. However, N_2O losses were greater for the camelina relay and the 'business as usual' cropping systems compared to the other two systems. These results highlight the importance of multiple complementary conservation or best management practices to reduce N losses from corn-soybean cropping systems.

**Denotes primary author*

Seeding Method Effect on Cover Crop Outcomes and Field Working Day Cost

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *Katie Black (University of Minnesota)*; M. Scott Wells (University of Minnesota); Gregg Johnson (University of Minnesota); Kent Cavender-Bares (Rowbot LLC)*

Farmers face a number of challenges that make cover crop integration difficult. One way to help address these barriers is to explore strategies that reduce production and time management risks, especially during establishment of cover crops. (Noland et al., 2018). New technologies are available that can help address time management and stand establishment issues during cover crop planting. Rowbot Systems LLC has developed a between-row, autonomous machine system (a "Rowbot") that operates in the gap between corn rows and can be run 24 hours a day. This platform can be used to plant cover crop seed in a way that mitigates timing issues associated with the window of opportunity and reduces the amount of time spent by the farmer to sow cover crops.

To investigate the potential of new seeding technology, e.g. a Rowbot, in a corn-soybean intercropping system, a study was conducted with two primary objectives:1) compare cover crop establishment and biomass by seeding method (high clearance seeder or RowBot technology) and 2) analyze the effect of lost field working day by interseeding method on system profitability. Two cover crops, field pennycress (*T. arvense*) and cereal rye (*S. cereale*), were interseeded into standing corn at two sites (Rosemount, MN and Waseca, MN) in late September of 2018 and 2019. Cover crops were photographed in April and May to assess canopy coverage and harvested in early June to assess biomass. After biomass harvest, cover crops were terminated. Soybean was planted, harvested, and assessed for yield. Field working days were calculated using a formula to determine trafficability of soils on a given day.

Preliminary results suggest significant differences in percent cover between the different planting methods, as well as a Rowbot resulting in increased field working days. This information can ultimately be used to increase adoption of cover crops and increase the number of ecosystem services provided by agriculture.

**Denotes primary author*

Short-Term Nitrogen Fertility Benefits of Cover Crops on Spring Wheat Production

Track: Conservation Models, Tools, and Technologies

Time: 3:00 PM - 4:30 PM CT

Authors: *David Archer (Agricultural Research Service)*; Raina Hanley (Agricultural Research Service); Holly Johnson (Agricultural Research Service); Robert Kolberg (Agricultural Research Service); Nicanor Saliendra (Agricultural Research Service); Mark Liebig (Agricultural Research Service)*

A challenge with managing cover crops is determining the fertility benefits they provide to the subsequent crop and accounting for these benefits in fertilizer application decisions. Previous research has shown that cover crops may take up nitrate N, so a traditional fall or spring soil test may show lower N availability following cover crops compared to no cover crop and indicate that a higher amount of N fertilizer should be applied. However, N that was taken up by the cover crops may become available to the crop later in the season, but there is currently no clear guidance on availability. A two-year study (2018-2019) was conducted near Mandan, ND within a long-term spring wheat-dry pea/cover crop rotation. A cover crop mix of forage soybean, spring triticale, Arvika pea, lentil, red clover, and purple top turnip was planted after dry pea harvest. Spring soil samples were collected before planting spring wheat, and N fertilizer was applied at four rates relative to the traditional soil test-based rate at: 60 lb N/ac below, 30 lb N/ac below, recommended rate, and 30 lb N/ac above. Spring wheat was monitored weekly using a ground-based active crop canopy sensor and a UAV-mounted multi-spectral camera. Spring wheat grain was harvested at the end to the season and yield, test weight, protein content, and gluten content were analyzed to evaluate responses to applied N. Soil tests were collected in the fall to measure remaining N in the soil. Initial results provided no indication that N fertilizer applications should be reduced relative to the traditional soil test recommended rates. More detailed results including recommendations based on remote sensing analysis will be provided. These results are important to producers and conservationists in understanding how fertilizer applications should be adjusted in response to use of cover crops, and the environmental impacts due to the interaction of cover crops and economically optimum fertilizer N applications on soil.

**Denotes primary author*

Building Resilience by Implementing the Three Key Goals of the Collaborative Eight-County Gulf-Houston Regional Conservation Plan

Track: One World, Connected through Conservation

Time: 3:00 PM - 4:30 PM CT

Authors: *Deborah January-Bevers (Houston Wilderness)**

The 8-county Gulf-Houston Regional Conservation Plan (RCP) is a long-term collaborative of environmental, business, and governmental entities working together to implement an ecosystem resilience plan for the expansive Gulf-Houston region through 3 Key Goals: (1) Increasing the current 14.7% in protected/preserved land in the eight-county region to 24% of land coverage by 2040; (2) Increasing and supporting the region-wide land management efforts to install nature-based stabilization techniques, such as green stormwater infrastructure, living shorelines and bioswales to 50% of land coverage by 2040; and (3) providing research and advocacy toward an annual increase of carbon sequestration in the region by 4% in native soils, plants, trees, and oyster reefs. The 4% soil carbon increase was chosen for its overlap with the global 4per1000 Initiative established in 2015 at COP21. Houston Wilderness facilitates the Gulf-Houston RCP, providing a bi-annual GIS-based database of a) all the nature-based infrastructure (NBI) projects in the region that are in need of full or partial funding (called the Working List of Projects), b) the currently funded NBI projects, and c) the amount of protected/preserved land in the 8-county region. With these databases and other corresponding research, the region is able to measure the progress being made toward achieving the 3 key goals. The Gulf-Houston RCP creates a road map for resilience against major storm events and other stressors across the 8-county region by providing Tools in the Resilience Toolbox to accomplish the goals. The 4% annual increase in organic carbon sequestration will occur mainly through large-scale targeted native tree plantings and will assist in reducing the CO2 concentrations in the atmosphere, which for the Gulf-Houston region is a substantial stressor. This abstract addresses how the Gulf-Houston RCP and the Tools in the Resilience Toolbox translate into resource conservation and environmental benefits.

**Denotes primary author*

Evidence on the Private-Excess Fertilization Hypothesis

Track: One World, Connected through Conservation

Time: 3:00 PM - 4:30 PM CT

Authors: *Yuyuan Che (Michigan State University)*; Hongli Feng (Michigan State University); David Hennessy (Michigan State University); Chaoqun Lu (Iowa State University)*

Nitrogen discharges into rivers and then large water bodies are responsible for ecological, amenity quality, local public finance and health problems throughout the world. Many believe that farmers use more fertilizer than is needed to maximize their profitability. Knowing more about whether farmers apply nutrients in excess of that which maximizes expected profit is important because it would open up possibilities for a variety of alternative policy instruments targeted at managing socially excessive levels of nutrient application. Empirically little is known about whether nutrients are applied beyond the level that maximizes a farmer's expected profit. This knowledge gap arises largely because limited crop-specific nutrient use data are available at sub-national levels of disaggregation.

We test whether nitrogen fertilizer use exceeds the privately optimal level and what factors affect farmer choices with a validated multi-decadal panel data of nitrogen fertilizer use rates, nitrogen use efficiency (NUE), and crop yield at county level for major crops in the United States. Nitrogen use rates are endogenous to market conditions, so we apply a two-stage estimation approach with natural gas prices as an instrument. We also investigate how nitrogen use rates and other factors affect NUE which is the proportion of nitrogen that one can reasonably infer has been harvested based on crop yield record and crop-specific nitrogen content. NUE has direct implications on nitrogen loss from farm fields. Preliminary results show that nitrogen is not in excess of its marginal private value at the average national level. In addition, a higher nitrogen price would reduce farmers' nitrogen use rates, while a greater crop price would encourage nitrogen use. These prices further affect NUE through the channel of nitrogen use rates, since greater nitrogen use rates would decrease NUE. Further robustness checks and methods are being conducted to cross check the results.

**Denotes primary author*

Stream Care for Streamside Landowners: A Collective Impact Approach to Community Conservation

Track: One World, Connected through Conservation

Time: 3:00 PM - 4:30 PM CT

Authors: *Jennifer Fear (Mecklenburg Soil & Water Conservation District)**

Districts across North Carolina increasingly face complex conservation problems in general isolation from each other equipped with traditional methodologies, training, and resources developed for problems historically confined within the fence lines of a farm. These break down as demographics continue to change within the state and districts expand their role to address environmental concerns generated beyond farm field borders. This trend will continue. Projections for North Carolina add a million new residents every decade for the next 20-30 years. The growth distribution is uneven but the pressure on natural resources will be felt everywhere. Likewise, resources among districts are uneven but uniformly rooted in a traditional, organizational mindset intended to address simple problems and generally lag rapid social, technological, and environmental changes. A different approach is warranted. We will present development of a cross-sector, cross-jurisdictional, and cross-district water quality initiative utilizing a Collective Impact methodology. This approach shifts focus to a network mindset that favors collaboration, growing a network, sharing/leveraging versus competing for resources, open-source knowledge, and cultivating leaders. This multifunctional framework and collaboration brings to bear resources and strategies that would otherwise be outside the reach of individual districts and which can then be customized for local context and leveraged to catalyze greater public education, outreach, and engagement.

At their heart, complex conservation problems are also social problems. Science alone is insufficient for addressing them. As noted in the Society's mission, conservation is part science and part art. Data undergirds the bridge between the two. Communicating that story that bridges science and art and brings the public actively into it, thereby effecting social change that leads environmental conservation and stewardship. In the end, that is our goal.

**Denotes primary author*

Use of Indicators of Soil and Water Quality to Monitor Shifts in Natural Resources and Climate

Track: One World, Connected through Conservation

Time: 3:00 PM - 4:30 PM CT

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

Our work addresses the design, technical measurements, and statistical methodologies used to link proximal soil point measurements taken across variable land-use and conservation to summary measures of water quality and climatic data at the Fort Cobb Reservoir experimental Watershed (FCREW) in Oklahoma, USA. Drainage sites where water samples are collected from within the 786 km^2 sized FCREW are in close proximity to soil sampling stations and meteorological and soil climate networks. Predicting soil and water quality at variable scale requires ground truthing of soil, water and climatic data. Additionally, a gap exists between implementation of best management practices and improved water quality due to intermediary processes between land management and watershed outcomes. Greater understanding of the processes connecting soil properties such as water infiltration and biological activity to water quality would strengthen water resource modeling, and help clarify when and how land management practices have desired water quality impacts. Specifically, we will illustrate how historically measured edaphic properties that include measures of soil quality, terrain attributes and conservation management can be correlated using geo-statistical approaches with changes in water quality. Our research inspires new approaches and collaborations that leverage soil quality to strengthen our understanding of the soil-water nexus through use of historic and current data at all spatial scales for research projects associated with the Long-term Agricultural Research (LTAR) and Conservation Effects Assessment Project (CEAP) national USDA initiatives. Future work will include FCREW as a Dynamic Soil Survey site that links RASTER (GRID) Soil Maps, Dynamic Soil Properties, Hydrology and Ecological Site Descriptions.

**Denotes primary author*

All Aboard! Using "Theory of Change" to Cultivate and Grow Stakeholder Engagement

Track: Outreach, Education, and Community Engagement

Time: 3:00 PM - 4:30 PM CT

Authors: *Jean Brokish (American Farmland Trust)*; Jill Kostel (The Wetlands Initiative); April Opatik (American Farmland Trust)*

The Illinois Sustainable Ag Partnership (ISAP) is comprised of fourteen organizations that work collaboratively to increase technical capacity of professionals and to utilize data and consistent messaging to encourage the adoption of in-field and edge-of-field practices. Efforts include development of a website with informational resources, demonstration tools that are shared among partners, and educational workshops and trainings.

In 2019, ISAP secured services of a part-time coordinator that expanded communications, engaged new partners, and increased organizational capacity for programs. While exciting, growth of an organization can be detrimental without clear goals to make informed and strategic decisions. Members of ISAP recognized the need for a plan and committed in 2020 to create a "Theory of Change" that identifies our desired impact along with the core strategies and enabling outcomes required to get there.

In addition to presenting our Theory of Change, we'll share the process we used to engage existing members and new stakeholders, lessons learned along the way, and how this document is driving our work forward.

**Denotes primary author*

Current and Future Impacts of Certified Crop Advisers on Conservation Practice and Technology Adoption

Track: Outreach, Education, and Community Engagement

Time: 3:00 PM - 4:30 PM CT

Authors: *Christopher Boomsma (American Society of Agronomy and Soil Science Society of America)*; Luther Smith (American Society of Agronomy and International Certified Crop Adviser Program); Leif Fixen (The Nature Conservancy); Carrie L. Vollmer-Sanders (The Nature Conservancy)*

Certified Crop Advisers (CCAs) play a pivotal role in conservation practice and technology adoption throughout the North American agriculture landscape. Due to their agronomic training and extensive in-field experience, they are deeply trusted by their farmer clients and are therefore critical decision makers "on the farm". Most are employed by either a farm input supplier or an agriculture retail or sales operation, though many are self-employed, independent consultants. Nearly 25% of CCAs serve more than 70 growers and over 50% of CCAs serve more than 25 farmers. Over 50% of CCAs service more than 20,000 acres of land for their respective farmers. With over 13,500 CCAs scattered across North America, their reach and impact are extensive. In this presentation, we will provide details on the results of an extensive survey among CCAs that uncovered the influence of these individuals on the adoption of conservation practices and key technologies on North American farms. We will discuss what CCAs perceive as impediments to the adoption of conservation practices by growers and what they see as likely trends in the larger sustainability movement. We will breakdown which technologies they and their clients employ to boost operational efficiencies and conserve resources. We will conclude by suggesting what organizations in the agricultural supply chain can do to engage CCAs so that these trusted advisers can help drive sustainability improvements across North America's diverse cropping systems.

**Denotes primary author*

Leveraging Corporate Engagement to Enhance Conservation Implementation across Diverse Communities

Track: Outreach, Education, and Community Engagement

Time: 3:00 PM - 4:30 PM CT

Authors: *Ashley Brucker (American Farmland Trust)*; Jean Brokish (American Farmland Trust)*

American Farmland Trust has long worked to protect farmland through a focus on soil health and best management practices. In recent years, this focus has incorporated outreach to underserved and minority communities through targeted engagement with new partners, specifically corporations, that can provide additional support and cooperation from stakeholders.

American Farmland Trust staff will share some of the challenges and lessons learned from working with corporations, along with results from three corporate partnerships each with a specific approach to implementing conservation. Tillamook County Creamery Association sponsored a microgrants program for farmers in urban areas surrounding 17 cities across the country. PepsiCo supported outreach and education to female landowners to increase the use of cover crops in their Illinois supply chain. Danone North America is engaging farmers through the entire dairy supply chain in Ohio and Kansas.

Overview of the three programs will demonstrate a variety of engagement and outreach techniques to close the gaps in offering conservation and cost share programs to a broader range of farms and farmers.

**Denotes primary author*

Virtual Soil and Water Conservation Education Efforts

Track: Outreach, Education, and Community Engagement

Time: 3:00 PM - 4:30 PM CT

Authors: *Lee Riley (University of Arkansas System Division of Agriculture Cooperative Extension Service)*; Julie Robinson (University of Arkansas System Division of Agriculture); Rita Watson (University of Arkansas System Division of Agriculture); Mike Daniels (University of Arkansas System Division of Agriculture Cooperative Extension Service); Andrew Sharpley (University of Arkansas); Matt Fryer (University of Arkansas System Division of Agriculture Cooperative Extension Service); Bill Robertson (University of Arkansas System Division of Agriculture); Mike Hamilton (University of Arkansas)*

Since 2018, the University of Arkansas System Division of Agriculture has integrated the efforts of the Arkansas Discovery Farms Program to develop and deliver virtual demonstration and educational experiences to an international network of participants providing time and cost savings by the ability to participate virtually. Demonstrations and educational sessions provided include virtual demonstrations of conservation benefits with respect to water quality, irrigation water use, climate change, soil health, and profitability/sustainability on selected research partner farms including existing Discovery Farms and soil health observation farms. Delivery of virtual educational opportunities and lesson plans related to soil health and water quality are available for high school science classes in a 45 minute – 1 hour time frames that teachers can incorporate into normal school day curriculum emphasizing conservation benefits with respect to water quality, irrigation water use, climate change, soil health and careers in conservation and agriculture. A coordinated marketing and outreach program among Extension and cooperating conservation partners has been developed to include promoting joint virtual training efforts and making non-formal demonstrations accessible through social media. Recorded virtual field demonstrations are available online, along with the lesson plans for high school science teachers. Lesson plans follow Next Generation Science Standards in the E7 and 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 Virtual Field Trips. To date, the virtual field trip series webinars have had 731 live viewers, 2,012 Facebook Live viewers, and 3,798 YouTube Views.

**Denotes primary author*

Advancing Methods for Monitoring Field-Scale Soil Movement

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Jessica A. Nelson (Iowa State University)*; Matt Liebman (Iowa State University)*

Soil research methods are relatively new compared to the soil and landscape formation phenomena being investigated. Consequently, there are many unanswered questions about these processes in both spatial and temporal dimensions. As the climate is changing, our landscape is also changing. To sustainably manage the land it is important to understand the effects of intensified precipitation and land use on soil loss and regeneration rates in agricultural watersheds. From 2016 through 2020, soil movement was monitored at six paired watersheds ($\bar{x}$=5.8 ha). Thirty pads were pinned to the soil surface at three landscape positions in each field and replaced 2-5 times throughout the growing seasons. Flumes were installed at the outlets and discharge of soil sediment was sampled. In addition to comparing rates of in-field soil movement with soil discharge at the bottom of each watershed, we conducted an ancillary experiment in 2020 at four sites to distinguish the short- and long-range sediment transport. Mean rates of soil movement (Mg ha^{-1} day^{-1}) onto pads within fields had a strong positive relationship with mean TSS loads (ppm) observed at the outlet of the watersheds ($p=0.002$). Local movement was responsible for the majority of in-field soil transport. These findings suggest that the in-field soil displacement patterns quantified using small mesh pads reflect sediment loads leaving a field and that the pad method could be an inexpensive alternative to other types of monitoring. Additional erosion calculations using RUSLE and WEPP will be compared with the mesh erosion pad method.

**Denotes primary author*

Incorporating a Precipitation Factor into the Soil Vulnerability Index Classification

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Quang A. Phung (University of Missouri)*; Allen Thompson (University of Missouri); Claire Baffaut (USDA–ARS)*

The Soil Vulnerability Index (SVI) developed by NRCS uses widely available inputs from the SSURGO database to classify agricultural land into four levels of vulnerability to sediment and nutrient losses: low, moderate, moderately high, and high. However, previous work has identified inconsistencies of vulnerability assessment across the United States, possibly because neither precipitation amount nor intensity are included in the SVI. Therefore, the objective of this research was to evaluate if inclusion of annual or seasonal rainfall characteristics can improve the ability of the runoff component of SVI to assess vulnerability to runoff and sediment yield. The study included six Conservation Effects Assessment Project (CEAP) watersheds in Ohio, Missouri, Mississippi, Georgia, Maryland, and Pennsylvania, selected for their range of rainfall characteristics. Sediment yields within each studied watershed were simulated using the Soil and Water Assessment Tool (SWAT) or the Annualized Agricultural Non-Point Source Pollution Model (AnnAGNPS) using precipitation data from 1985 to 2014 from all watersheds. The Universal Soil Loss Equation (USLE) R-factor is one means to describe the effect of rainfall on sheet and rill erosion. Annual R-factors, which ranged from 189 to 390, were compared with the simulated sediment yields. Preliminary results indicated that the SVI classification of fields in each watershed could shift to more or less vulnerability due to changes in precipitation characteristics. The coefficient of determination (r^2) between R-factors and sediment yields ranged between 0.50 and 0.97, with most values greater than 0.7. This study will discuss how R-factors help explain the shift in SVI classification caused by differences in precipitation.

**Denotes primary author*

Soil Organic Carbon Sequestration Calculated from Depth Distribution

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

Time: 3:00 PM - 4:30 PM CT

Authors: *Alan J. Franzluebbers (USDA-ARS)**

Loss of organic matter from soils in the southeastern US has been extensive due to historical practices of conventional tillage and long fallow periods, resulting in oxidation and erosion. However, conservation agricultural systems (like no tillage, cover cropping, residue management) have been developed and adopted by many farmers in the region and there is likely significant sequestration of soil organic carbon occurring on these farms. Sequestration is the removal of carbon dioxide from the atmosphere and its storage in the soil. A new method was developed of calculating soil organic carbon sequestration that does not require detailed side-by-side comparisons or lengthy investigations over time. This new method requires multiple depth sampling of the soil profile to determine a mathematical distribution of soil organic carbon. Data from several published research projects showed that this method gives comparable estimates as more traditional approaches, but with much less resource expenditure. This approach can be used on private farms to determine the extent of soil organic carbon sequestration. This research will help researchers, agronomic advisors, and farmers to better assess agricultural management.

**Denotes primary author*

POSTER PRESENTATIONS

Adapting Landscapes to Climate Change

Poster Number: 1

Title: Influence of Management and Cover Crop Selection on Early Indications of Change in Soil Health under Organic Agriculture

Authors: *Leah Ellman-Stortz (Texas A&M University)*; Katie Lewis (Texas A&M Agrilife); Terry Gentry (Texas A&M University); Paul De Laune (Texas A&M Agrilife)*

Demand for organic products has increased in recent years with elevated consumer interest in sustainability, but certification through the United States Department of Agriculture (USDA) requires three continuous years of management with yield-reducing restrictions on inputs. To combat losses, growers are encouraged to utilize cover crops, which may improve soil health by stimulating microbial activity and reducing wind erosion. However, many Texas growers are reluctant to use cover crops due to concerns over water usage. Therefore, the purpose of this study was to investigate the impact of cover crop selection on soil health in West Texas, specifically for agricultural plots recently transitioned to organic management.

This study was conducted at the Texas A&M AgriLife Research Extension centers in Lubbock and Vernon, TX. Plots were planted to cotton and peanut during the summers of 2019 and 2020, respectively. The experimental layout was a randomized complete block design for both organic and conventional agriculture. Cover crop treatments included cereal rye (*Secale cereal*), radish (*Raphanus sativus*), hairy vetch (*Vicia villosa*), and mixes. A split-plot trial was the main focus of this study, which compared various cover crop treatments under organic and conventional management.

Current gas flux data from conventional treatments indicated elevated respiration under plots treated with cover crops as compared to the fallow, but few significant differences were observed in terms of mineralizable carbon or enzyme activity, and cover crop selection did not appear to have a significant impact on any of the parameters studied.

This was also the case under the split-plot trial, where cover crop selection appeared to have little impact on gas fluxes, mineralizable carbon, or enzyme activity. However, significant differences in these parameters did appear according to management practice, marking potential early indications of change in soil health.

*Denotes primary author

Poster Number: 2

Title: Narrow Rows Are a Potential Management Tool to Increase Grain Yields, Total Biomass, and Water and Nitrogen Use Efficiencies in Irrigated Systems

Authors: *Jorge A Delgado (USDA)*; Bradley Floyd (USDA-ARS); Amber Brandt (USDA); Robert D'Adamo (USDA)*

We conducted studies from 2018 to 2020 about the potential use of narrow rows and nitrogen fertilizer to increase yields and nitrogen and water use efficiencies in a Fort Collins clay loam soil at the Colorado State University-Agricultural Research, Development and Education Center (ARDEC) near Fort Collins, Colorado. Precipitation was monitored at a weather station near the plots and irrigation was applied with a lateral move sprinkler irrigation system. Statistical analysis showed that in every study, grain production and/or total biomass was increased by narrow rows and nitrogen fertilization. None of the four studies reduced yields of biomass or grain with narrow rows. Narrow rows increased biomass grain (146 days after planting [DAP]) production in three of the four studies, harvested grain (173 days DAP) in two of the four studies, and total biomass production in three of the four studies. All studies increased yields and/or total aboveground production, increasing water and nitrogen use efficiencies. These studies suggest that narrow rows are a potential best management practice to increase yields, economic returns for farmers growing silage and/or grain corn, and efficiency of water and nitrogen inputs in sprinkler-irrigated systems of the western United States.

*Denotes primary author

Poster Number: 3

Title: Silvopasture Production Characteristics in the Coastal Plain Of North Carolina

Authors: *Alan J. Franzluebbers (USDA-ARS)*; Matt Poore (North Carolina State University)*

Silvopasture can offer beef cattle relief from heat and humidity that are prevalent in the long summers of the Coastal Plain of North Carolina. We determined forage yield characteristics, early timber production values, and beef cattle responses from two adjacent fields with and without trees used for cattle grazing mixed swards of native warm-season grasses. Longleaf pine, loblolly pine, and cherrybark oak plots were planted in triplicate lines surrounding either 40- or 80-foot wide alleys in 2007. Following 6 years of corn-soybean rotation in alleys, forage mixtures of switchgrass, big bluestem, indiangrass, and eastern gamagrass were established in 2014 (tree pasture) and 2015 (open pasture). Beef cattle were stocked in the middle of summer 2016 and every summer since then. Tree survival was better with loblolly pine than others, but all had survival rates >85%. Tree diameter (at breast height in Year 9) averaged 6 1/4" for loblolly pine, 4 3/4" for longleaf pine, and 2 3/8" for cherrybark oak. Forage biomass cut for hay was 2.2 to 3.1 ton/acre in 2017. Nutritive value of grazed warm-season native grasses was consistent, but relatively low at 6.5% protein. Animal gains are being assessed in both rough-haired and slick-haired Angus x Senepol heifers. Our results will be useful to landowners in the region considering thinning timber to silvopasture or planting trees in perennial pastures to develop long-term viability of agricultural landscapes.

*Denotes primary author

Adaptive Management of Conservation Efforts

Poster Number: 4

Title: Adaptive Management of Longleaf Pine with Prescribed Burning

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

A longleaf pine stand was planted in January, 2009 after a stand of loblolly pine was clear-cut and the area was treated with a standard herbicide application. The stand was not burned by prescription before planting so the amount of logging slash remaining on the site was excessive. Four years after the planting, when the longleaf pine plants were beyond the 'grass stage' at which they will tolerate fire, the stand as burned by an expert prescribed burning crew. The stand that developed after the prescribed burn had significantly less woody debris and it had much more shrubby cover. The stand was burned on a 3-year burn interval in 2016 and then again on a 2-year burn cycle in 2018 and 2020. The frequency of burning was increased to try to control deciduous woody plants more effectively without herbicides. With the increase in burn frequency, cover of shrubs and hardwood tree saplings did decrease.

*Denotes primary author

Poster Number: 5

Title: Native Perennial Grasses as Circular Buffer Strips Improve Green Water Use Proportion in a Center Pivot Irrigation System

Authors: *Paramveer Singh (New Mexico State University)*; Sanghamesh Angadi (New Mexico State University); Robert Lascano (USDA-ARS); Sultan Begna (USA-ARS); Dave Dubois (NMSU); Rajan Ghimire (New Mexico State University); Omololu J Idowu (New Mexico State University)*

Circular Grass Buffer Strips (CBS) is a simple, and cost-effective strategy of rearranging the dryland portion of a partial pivot into circles of buffer strips of native perennial grasses alternating with crop strips. The system can offer multiple benefits such as improvements to water cycle from enhanced conservation of heavy intensity rainfall, reduced evapotranspiration losses and improved crop water productivity due to reduced stress and improved microclimate. To understand benefits of CBS, observations were made around a 57 and 44 mm of rain event in 2019 and 2020, respectively in the ongoing CBS project at the Agricultural Science Center, Clovis NM. The crop strips of CBS were able to capture and store 78 and 43% of the total rainfall in 2019 and 2020, respectively. Without circular strips of perennial grasses (CONTROL-CT), only 55 and 25% of the total rain was retained. Over the course of 7, and 4 days from the rain event, corn in CBS extracted 7 and 2 mm more soil water than CT. This extra amount of water extracted was enough to reduce water stress experienced by corn, as leaf water potential in CBS was 9 and 12% less negative than CT during two respective seasons. Attributing to reduced water stress levels, CBS accumulated 6 and 22% more biomass than CT over a period of 20 and 10 days in 2019 and 2020, respectively. With dwindling ground water reserves of Ogallala Aquifer, improving rainwater conservation is of paramount importance. Certainly, the results from two rain events indicates that a simple modification of a center pivot landscape with native perennial grasses as CBS, storage and use of rainwater by irrigated agriculture increased which alleviated crop water stress and improved crop growth.

*Denotes primary author

Poster Number: 6

Title: 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.

*Denotes primary author

CIG Showcase

Poster Number: 7

Title: Adopt, What? Describing Louisiana Wheat Producers' Level of Adoption of Soil Health Management Practices

Authors: *Maureen Victoria (Texas A&M University)*; Holli Leggettee (Texas A&M University); Jamie Foster (Texas A&M AgriLife Research); Katie Lewis (Texas A&M Agrilife); Josh Copes (LSU AgCenter); Haly Neely (Department of Crop and Soil Sciences, Washington State University); Clark Neely (Department of Crop and Soil Sciences, Washington State Unversity); Perejitei Bekewe (Soil and Crop Sciences, Texas A&M University); Jean Parrella (Texas A&M University)*

Soil conservation and management require producers to make informed decisions using evidence-based information. The purpose of our qualitative study was to investigate Louisiana wheat producer's level of adoption of soil health management practices (SHMPs) using Rogers' (2003) five adopter categories. We interviewed six of the 39 Louisiana wheat producers using a semi-structured interview protocol and transcribed the interviews for data analysis using the five adopter categories within Rogers' diffusion of innovation theory as the framework. We followed initial data analysis with secondary data analysis to confirm the analysis. Our findings indicated that most participants in our study are willing to adopt soil health management practices given the appropriate information, climate, soil conditions, and timing of implementation. These parameters are essential for the appropriate dissemination of scientific information to producers. Innovators in our study posed exceptional views of technology in the field and were highly interested in receiving the most current information about practices and equipment. In alignment with Rogers' characteristics of early adopters being discreet in their adoption of innovations, early adopters adopted SHMPs despite conventional practices being used on neighboring farms for soil nutrient and erosion control. Participants who intensively and continuously monitor their soil and crops to make SHMP decisions are considered early majority adopters. Late majority adopters in our study adopt innovations given the guarantee of finance and yield increases. Dissimilar to laggards, participants that aligned with late majority were not suspicious of innovations but lacked the necessary scientific information to adopt SHMPs. These findings reveal the need for region-specific scientific information to be appropriately disseminated to wheat producers. Adoption of SHMPs could improve data-driven information delivered through Extension-hosted trainings.

*Denotes primary author

Poster Number: 8

Title: Assessing the Impact of a White Clover Living Mulch on Hydraulic Soil Properties in Some Georgia Cropping Systems

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

Annual cover crops are commonly grown in rotation with standard 'cash crops' such as corn and cotton to improve soil quality, reduce erosion, and retain nutrients. The use of perennial cover crops such as white clover (*Trifolium repens* var. 'Durana') as a 'living mulch' has indicated the potential for improving soil quality and crop production compared to annual cover crops. In particular, preliminary results have indicated the importance of adequate soil moisture for maintaining the white clover from one year to the next which illustrates the importance of quantifying the relationships between physical soil properties controlling soil moisture dynamics and plant growth in these systems. The objective of this work is to develop pedotransfer function models from a suite of measured physical parameters to allow for the prediction of these hard-to-measure hydraulic properties. Soil samples from three agricultural systems in the Georgia Piedmont and Coastal Plain including corn (*Z. Mays*), cotton (*Gossypium* L.), and pecans (*C. Illinoinensis*) will be combined to identify 1) the control of soil moisture conditions on clover and cotton/corn growth and 2) the possible benefits of the living mulch on improving soil hydraulic function and subsequent water holding capacity. Measured properties in each management system include infiltration rate, water holding capacity, aggregate stability, bulk density, and soil strength. Furthermore, soil moisture measurements from a cotton experiment with four cover crop treatments will be compared to these same physical soil property measurements to better understand the impact of common cover crops on soil moisture dynamics compared to the living mulch system. Understanding the impact of a continual cover crop of white clover will have significant implications for farmers and land managers across the region.

*Denotes primary author

Poster Number: 9

Title: Enhancing Agricultural Production for Native American and Socially Disadvantaged Farmers and Ranchers

Authors: *David Stephens*

From 2017 to 2021, the Oklahoma Black Historical Research Project, Inc. worked in partnership with the Oklahoma Tribal Agriculture Advisory Council, Langston University, Oklahoma State University, the USDA Natural Resources Conservation Service (NRCS) and the Rural Coalition to promote the use of solar water well systems. The State of Oklahoma had drought conditions each year. Although Solar powered water well systems have been in use for several years, the OBHRPI staff recognized that most Native American and other Socially Disadvantaged Farmers and Ranchers the staff worked with, did not fully understand the technology and the benefits of using it in their operations.

The main goals of the CIG Project were to introduce Native American and other Socially Disadvantaged farmers to Solar Powered Water Well Systems, complete installation of Solar Water Well Systems for demonstration projects, fully compliant with the USDA Environmental Quality Incentive Program (EQIP), and establish a baseline of ag production for the first year.

At the start of the project the Environmental Quality Incentive Program (EQIP) Cost Share covered a percentage of the cost of the drilling and casing separately from solar, windmill or electricity. Over the course of time as we worked with farmers their demand for one complete unit influenced the NRCS to offer the cost share on one complete solar water well unit. One example is as follows:

In East Central Oklahoma, one NRCS Team reported that they had the following solar water wells established under EQIP: Bristow, Creek County – 10; Chandler, Lincoln County – 4; Okemah, Okfuskee County – 2, and Shawnee, Pottawatomie County – 2. Total 18 – Of the 18, 13 are in the Historically Underserved Category.

We (OBHRPI) were able to introduce 6,454 Native American and other Small Socially Disadvantaged farmers along with agriculture professionals to Solar Powered Water Well Systems. 30 community meetings, 5 conferences and 12 ZOOM Webinars were held, 15 demonstration projects were established, and more than 1,363 hours were spent on farm visits and calls with farmers.

*Denotes primary author

Poster Number: 10

Title: Evaluating the Effect of Cover Crop on Runoff Water Quality

Authors: *Jose O. Payero (Clemson University)*; Michael W. Marshall (Clemson University); Bayleah Cooper (Clemson University); Udayakumar Sekaran (Clemson University)*

Pollution of surface and groundwater resources with contaminants such as soil sediments, crop nutrients, and pesticides derived from agricultural production is a significant problem. Farming practices and production systems that reduce pollution are needed to sustain agricultural production while protecting the environment. One of these practices that could mitigate water resource pollution is planting a cover crop rather than keeping the soil fallow during the winter and early spring months. However, there are still questions about the magnitude of the effect of cover crops on water quality under different conditions. Therefore, the objective of this study was to evaluate the effect of cover crops on runoff water quality in the humid southeast USA. A replicated field experiment conducted at Clemson University near Blackville, South Carolina, compared a cover crop treatment with a control treatment (no cover crop) from 2018 to 2020. Runoff water samples were collected from each experimental plot during rainfall events using an automated flume and water sampling system. The water samples were analyzed for water quality variables, including total dissolved solids and crop nutrients. The results obtained during the study will be presented and discussed.

*Denotes primary author

Poster Number: 11

Title: Integrating Conservation Tillage and Summer Cropping Into Wheat Production Systems

Authors: *Jamie Foster (Texas A&M AgriLife Research)*; Perejitei Bekewe (Soil and Crop Sciences, Texas A&M University); Haly Neely (Department of Crop and Soil Sciences, Washington State University); Clark Neely (Department of Crop and Soil Sciences, Washington State Unversity); Lauren Tomlin (Texas A&M University); A. Peyton Smith (Soil and Crop Sciences, Texas A&M University); Ayush Gyawali (Soil and Crop Sciences, Texas A&M University); Katie Lewis (Texas A&M Agrilife)*

Wheat (*Triticum* sp.) is one of the top five cash crops in Texas. Typical management is full-tillage and summer fallow when temperature and wind facilitate loss of soil moisture and erosion. Conservation management, such as reduced tillage, summer double or cover cropping, or their integration, would improve soil health. Adoption of conservation management by wheat producers is low due to a lack of information. Three locations in Texas were planted to a research study to evaluate wheat-double cropping under different tillage regimes in 2016. There are three replications in a randomized complete block design with split-plots where main plots are full-, strip-, or no-tillage, and subplots are summer crop. Summer crops include cowpea (*V. unguiculata*), sesame (*S. indicum*), sorghum (*S. bicolor*), seven species mixture (buckwheat [*F. esculentum*], cowpea, guar [*C. tetragonoloba*], lablab [*L. purpureus*], sunflower [*Helianthus* sp.], pearl millet [*P. glaucum*], and crotalaria [*C. juncea*]), or fallow. When significant, wheat grain yields varied by location and year. In 2020 at Beeville, wheat yield was greater under no- than full-tillage and summer crops reduced wheat yield compared to fallow. At Lubbock, wheat yield was greater for strip- than full-tillage in 2017 but vice versa in 2019, and yield was greater with sorghum in 2020. Full-tillage resulted in lesser wheat yield than other tillage treatments in 2016 and greater yields in 2017 and 2019 at Thrall. Wheat yield was reduced by sorghum in 2018 but increased by sorghum and sesame in 2019 and 2020. At Thrall, active C (POxC) and Beta glucosidase (microbial enzyme) activity increased with sorghum compared to fallow. At Beeville, POxC was greater for sorghum compared to the fallow plots. Additional measures on soil chemical and physical characteristics will be presented. This research will be used for economic evaluation and incorporation of social science to influence shifts to conservation management of wheat.

*Denotes primary author

Poster Number: 12

Title: Integrating Cover Crops and Manure: Developing Best Management Practices

Authors: *Manuel J. Sabbagh (University of Minnesota)**

Cover crops (CC) may improve soil and environmental health, particularly when integrated with livestock manure application. However, CC adoption rates in the upper Midwest are low due to a short CC growing season. A strategy that may expand the CC growing season and improve CC adoption rates may be to plant CC prior to manure application and utilize low-disturbance manure applicators. This study seeks to identify best management practices of integrating liquid-injected manure and CC by measuring their impacts on soil health, nutrient cycling, and row-crop productivity. Field trials were initiated in fall 2019 at the University of Minnesota West Central Research and Outreach Center near Morris, MN. The study was laid out in a randomized complete block design with split plot in two rotation systems, continuous corn (*Zea mays*) and a soybean (*Glycine max* [L.] Merr.)-corn rotation system. Main plots included sweep-injected liquid manure to reduce soil disturbance and subplots had a cereal rye (*Secale cereale*) and annual ryegrass (*Lolium multiforum*) CC mixture. Cover crops were planted at various stages of row-crop development for both rotation systems. Manure was applied in the late fall when soils were at or below 10°C for both rotations, whereas the continuous corn rotation also contained an early fall manure treatment when soil temperatures were above 10°C. A control without CC or manure was included. Soil samples were taken from the 0-15, 15-30, and 30-60 cm soil depths at various time points throughout the CC and row-crop growing season. A thorough analysis measuring nutrient cycling, soil health, and agronomic response is underway.

*Denotes primary author

Poster Number: 13

Title: Maximizing Summer Cover Crop Conservation Benefits for Improved Vegetable Production

Authors: *Adria Fernandez (University of Minnesota)*; Julie Gross (University of Minnesota); Naomy Candelaria Morales (University of Minnesota); Madison Moses (University of Minnesota); Anne Pfeiffer (University of Wisconsin)*

Nitrogen fertility is a challenge in organic vegetable cropping systems. Cover crops can contribute to soil N stores through biological N fixation and through uptake and retention of excess N. However, to realize benefits to crops, the release of N from incorporated cover crop biomass must coincide with the needs of the following vegetable crop. Cover crops also provide an opportunity to enhance rotations with flowering habitat and forage for pollinators and beneficial insects. While farmer interest is high, adoption is hindered by lack of knowledge about optimal management, potential for nitrogen delivery, soil health improvement, and beneficial insect services within vegetable rotations. The tribal White Earth Department of Natural Resources and the Immigrant Farmer Training Program at Big River Farm are hosting on-farm trials and partnering with University of MN researchers and the Xerces Society in the development of educational tools, events, and resources to reduce barriers to entry for historically underserved farmers and allow increased cover crop utilization. This project evaluates the performance and agroecosystem benefits of six single- and mixed-species cover crops when planted in two warm-season rotational positions: before fall broccoli, and after spring lettuce. Field trials were established in 2020 in two Minnesota locations. Data was collected on (1) stand quality and biomass production; (2) soil available N and potentially mineralizable N during cover crop growth and following incorporation; (3) N leaching below crop rooting depth, (4) cover crop flowering periods; and (5) abundance and diversity of visiting insects. First-year dry biomass production ranged from 2,305 kg/ha (late-planted crimson clover) to 5,987 kg/ha (early-planted pea/oat mix). Visits were observed from members of 17 beneficial insect families. Full results will be used to develop a region-specific guide to cover crop insect benefits, and cover crop selection and management factsheets.

*Denotes primary author

Poster Number: 14

Title: Nutrient Management Cooperatives in California's Lower Salinas and Monterey Bay: Modelling Partnerships for Improving Water Quality in Irrigated Lands

Authors: *Natalie Solares (Resource Conservation District of Monterey County)**

The project has used a collaborative approach for developing and testing multi-farm water quality cooperative efforts to pool resources for more efficient compliance with state water quality regulations and to make conservation practices more widely applicable in the Lower Salinas Watershed. The collaborative team was initially composed of four non-government conservation organizations and the Grower-Shipper Association of Central California. The cooperative concept was a framework for strategic monitoring of on-and off-farm treatment areas to support farmers in achieving Total Maximum Daily Load targets in the Moro Cojo watershed. The project had five components (1) on-farm irrigation and nutrient management assessments (2) off-farm water treatment projects (3) GSA-provided guidance from the agricultural industry perspective (4) engage stakeholders with regulatory agencies to facilitate uptake of the cooperative model into regional and state policy and (5) expand a nutrient fate and transport model to the pilot sub-watersheds. Farms had their irrigation and nitrogen applications monitored for confirmation of local best practices. Off-farm water quality treatment wetlands were monitored for their effectiveness at reducing nutrients and nutrient loads in the surface waters passing through them. Project partners presented the watershed cooperative approach to improve water quality with the Central Coast Regional Water Quality Control Board. Partners developed a Tank-In-Series model for determining locally valid decay rate of nutrient for sizing woodchip bioreactors to inform future cooperative treatment project development. Using output from the off-farm water quality treatment wetlands in the Moro Cojo Slough along with the farmer and organizational cooperation, partners submitted a request for 303(d) de-listing for nitrogen-related water quality degradation in the watershed to the California State Water Resources Control Board.

*Denotes primary author

Poster Number: 15

Title: Practical Methods to Assess and Manage Soil Biology on a No-Till Urban Farm

Authors: *Allen Skinner (Clara White Mission)*; Mallory Schott (Clara White Mission)*

One of the key indicators of good soil health is diverse and plentiful beneficial soil microorganisms found in the soil food web. Other indicators of good soil health, like mineral content and organic matter have established, low cost ways to assess these aspects. However, because soil biology is a dynamic and complex component of soil, soil biology testing methods are more elaborate and expensive.

Farmers of all acreages need cost effective tools to assess soil biology and to monitor levels in order to make soil amendment decisions. In addition, soil amendments should be tested before applying to ensure that beneficial, not pathogenic microbes are added to soil. The microscope is such a tool and should be part of a farmer's tool kit much like a broad fork or seed drill is. The $800 microscope setup plus some training to be familiar with how to assess a soil or soil amendment sample allows a farmer to quickly and affordably assess their soil, establish an initial baseline and chart soil improvement over time. Charting soil biology levels over time allows the farmer to cost effectively manage and customize soil amendments to meet the target levels of microbe levels established. While there are many tools to assess soil health available, the microscope method is a VISUAL method that allows one to SEE what is going on and to be able to understand much more about your soil for such aspects as disease-causing microbes, anaerobic soil conditions, types of nematodes present in soil, etc. Improvement of soil biology also correlates with other metrics like improved yields and nutrient density (Brix) as well as reduced fertilizer and soil amendments. By being able to perform real time soil biology assessments, farmers can more precisely manage their input costs and still achieve their yield and quality goals.

*Denotes primary author

Poster Number: 16

Title: Preference towards Nitrogen Forms Differs in Common Fig (*Ficus carica*) and Knockout Rose (*Rosa radrazz*)

Authors: *Dharma S Pitchay (Tennessee State University)**

Right Nitrogen rate, source, timing and method of application is emphasized in container production and least on the form of nitrogen i.e. ammonium (NH_4^+) versus nitrate (NO_3^-). These are the two major N-forms of nitrogen taken by plants. Most plants prefer combination of both rather than absolute supply of either forms. Optimal requirement of NH_4^+ or NO_3^- varies with plant species and environmental conditions. Studies were conducted on selected species i.e. Common fig and Knockout rose's preference to N-forms. Plants were supplied with 15 mM nitrogen at five NH_4^+:NO_3^- ratios (0:100, 25:75, 50:50, 75:25 and 100:0) and grown in peat and pine bark mixture (1:10 volume to volume) substrate. Experimental units were arranged in a randomized complete block design with five treatments and six replications. In both species, yield, and aestheitic indexvalue were significantly reduced at higher NH4+ -nitrogen ration. Fig plants supplied with 50:50 and 25:75 had significantly larger canopy size and fruits. In rose plants supplied with 0:100 and 25:75 had significantly larger canopy, flower number and aesthetic beauty. In addition, compared to 0:100, plants supplied with 100:0, 75:25 and 50:50 had 72.23, 68.09 and 51.69% reduced canopy, 91.93, 79.74 and 63.03% reduced flower number and 67.36, 37.05 and 28.19% reduced aesthetic beauty, respectively. Rose had significantly low tolerance to NH_4^+ nutrition. Stunted growth, chlorosis, necrosis and abscission of lower matured leaves were toxicity symptoms developed in rose and fig at > 25 and 50% NH_4^+, respectively. Common fig performed better with combined supply of NH_4^+ and NO_3^- than single supply of either one. On the other hand, rose preferred <75% NO_3^-. Limitation NH_4^+ in the nutrient solution was 25 and 50% for fig and rose, respectively. Delivery of right N-form minimize N-leaching and optimizes N-uptake and use efficiency.

*Denotes primary author

Poster Number: 17

Title: Revising and Implementing Phosphorus Indices to Protect Water Quality in the Northeastern United States

Authors: *Quirine Ketterings (Cornell University)*; Karl Czymmek (Cornell Univeristy); Mart Ros (Cornell University); Martin Battaglia (Cornell University); Douglas Beegle (Penn State); Peter Kleinman (USDA-ARS); Joshua Faulkner (University of Vermont); Jeffrey Carter (University of Vermont); Amy Collick (University of Maryland Eastern Shore); Zach Easton (Virginia Tech University); Masoud Hashemi (University of Massachusetts); Thomas Morris (University of Connecticut)*

Most U.S. states developed phosphorus indices (PIs) to score agricultural fields for relative risk of P loss so beneficial management practices (BMPs) can be implemented to reduce P loss risk from high-risk areas. An earlier PI evaluation among Chesapeake Bay States (USDA-CIG 68-3A75-12-226) resulted in a proposed new transport x BMP approach rather than the more commonly used source x transport approach. With current USDA-CIG funding (69-3A75-17-26) we explore the potential for this new approach to be used in NY and across the Northeast. In addition to planner surveys, the project included a soil test P comparison, modeling of manure BMPs for watersheds in NY, PA, and VT using SWAT-VSA, and evaluation of impact of a new PI on BMP selection and manure management across 22 farms. Manure BMP scenarios for model analyses included practices applicable across state boundaries (timing, surface versus subsurface placement, rate of application, ground cover, and soil tillage practices). The project resulted, in December 2019, in the release of NY-PI 2.0 which was added to the NY 590 nutrient management standard (2020 update) and will become part of comprehensive nutrient management plans for concentrated animal feeding operations (CAFOs) when NY's CAFO permit is renewed (2022). The NY-PI 2.0 includes four soil test P categories: <40, 40-100, 100-160, > 160 lbs P/acre Morgan, roughly equivalent to <11, 11-23, 23-35, and >35% P saturation based on Mehlich-3. Study findings combined with farmer and planner feedback showed the NY-PI 2.0 accurately identified high risk fields and incentivizes implementation of BMPs accordingly. Consulting firms in NY are currently implementing the NY-PI 2.0 into their software and planning cycles. Other ongoing work includes expansion of the evaluation of impact of BMP selection on manure management to more farms and continued discussions about adapting/adopting a similar approach across the Northeast for improved P management and water quality.

*Denotes primary author

Poster Number: 18

Title: Securing the Future of Highly Productive Organic No-Till Vegetable Cropping Systems in California

Authors: *Jeffrey P. Mitchell (University of California, Davis)*; Anil Shrestha (California State University, Fresno); Eric Brenna (USDA ARS Salinas, CA); Cynthia Daley (California State University, Chico); Jessica Chiartas (University of California, Davis); Lee Altier (California State University, Chico); Garrett Liles (California State University, Chico); Amber Vinchesi-Vahl (University of California Cooperative Extension Sutter County); Sarah Light (University of California Cooperative Extension Sutter County); Scott Park (Park Farming); Brian Park (Park Farming); Paul Muller (Fully Belly Farm); Andrew Brait (Full Belly Farm); Phil Foster (Pinnacle Organic Farm); Tom Willey (T & D Willey Farms); Darryl Wong (University of California, Santa Cruz); Nathanael Siemens (Rodale Institute); Arianna Bozzolo (Rodale Institute)*

A network of experienced organic vegetable farmers in Hollister, Meridian, and Guinda, CA, is working with University, USDA-ARS, and private sector partners to develop improved performance production systems that rely on less tillage disturbance. Each farm is conducting evaluations to test practices for terminating cover crops, establishing a variety of vegetables using reduced disturbance practices that preserve residues, and inserting cover crops into their crop rotations as frequently as possible to extend the period of green cover over the soil. Limited success has been achieved with the combination of mechanical rolling and mowing sufficiently mature cover crops but not however, with roller-crimping alone. Between-row mowers and roller crimpers have also been attempted, but with limited success. Since the project started in 2018, several new practices have been instituted in side-by-side demonstration evaluations including efforts to increase the use of cover crops both between and in cash crops, strip-tillage vegetable crop establishment, cover crop grazing by sheep, and the use of shade cloth mulch over mowed cover crops. The strengths of this effort have been frequent farmer-to-farmer-to-researcher information and experience sharing, farm visits, update videos on YouTube, and televideo conferences that are organized to enable discussions and feedback on topics of interest to participating farmers. The ongoing effort now has over 100 affiliates. Practices used in the project have evolved over the years based on farmer experience, and demonstrate the practical challenges and hurdles that pioneering organic farms in California face as they work to make incremental improvements soil management in their systems.

*Denotes primary author

Poster Number: 19

Title: Small Grains in the Corn Belt: Large Impacts

Authors: *Lydia English (Practical Farmers of Iowa)*; Alisha Bower (Practical Farmers of Iowa); Sarah Carlson (Practical Farmers of Iowa); Rebecca Clay (Practical Farmers of Iowa); Elizabeth Reaves (Sustainable Food Lab); Patrick Lawrence (Sustainable Food Lab)*

Extending the two-year corn-soybean cropping rotation to include a small grain lessens the environmental externalities that the current Midwest cropping system perpetuates. However, even with farmer interest in diversified cropping rotations, a lack of robust technical support and viable markets can render this practice unfeasible. Because of investment from a Conservation Innovation Grant from the Natural Resource Conservation Service, Practical Farmers of Iowa (PFI) and the Sustainable Food Lab have been able to de-risk the process of farmers adding a small grain into their cropping rotation by providing cost share and grower support since 2017. Furthermore, the cost share has increased direct buying of small grains from companies like Oatly, Smithfield and ADM, as well as elicited private investment, driving a market pull for these crops. Hear an update from PFI's small grain programming, including our work to build lasting markets and supply chain investment, our work to quantify the economic impacts of diversifying a rotation, and our work to demonstrate the environmental benefits that extended rotations afford.

*Denotes primary author

Poster Number: 20

Title: Soil Health on Farms Focused on Forages in North Carolina

Authors: *Alan Franzluebbers (USDA-ARS)*; Matt Poore (North Carolina State University); Johnny Rogers (North Carolina State University)*

How they are managed can have important implications on a wide range of ecosystem services, not just on agricultural productivity. Overgrazed pastures become marginally productive and lead to soil dysfunction, poor water quality, loss of biodiversity, and source of greenhouse gas emissions. Well-managed pastures can be highly productive and lead to excellent animal performance, contribute to soil health through balanced nutrient cycling that also promotes watershed health, provide haven for wildlife, and can sequester carbon in soil to reduce greenhouse gas emissions. Farmers were enlisted in an educational effort through the Amazing Grazing program at North Carolina State University to manage grazing following sound ecological principles to foster productivity, profitability, and environmental stewardship. On-farm trials and hosting of educational events on farms were part of this program. Research was conducted on three targeted aspects of the farm operation to better understand potential and limitations of better management. These focus areas were on (1) spatial nutrient distribution on nine farms in North Carolina to assess landscape effects of management, (2) nitrogen management of fall-stockpiled tall fescue as a function of soil health condition, and (3) use of annual forages for renovating perennial pastures and improving soil health condition. Results will be shared focused on these on-farm approaches. Farmers responded positively to hands-on activities and engagement in research activities. Workshop attendees were interested, attentive, and motivated to adopt new practices based on these practical demonstrations on peer farms.

*Denotes primary author

Poster Number: 21

Title: Tradeoffs between Soil Health and Soil Moisture on Water-Limited Farms in South Texas: Findings of the Subtropical Soil Health Initiative

Authors: *Mike Morris (National Center for Appropriate Technology)*; Alex Racelis (University of Texas Rio Grande Valley); Lindsey Richards (University of Texas Rio Grande Valley); Stephanie Kasper (University of Texas Rio Grande Valley); Faeqa Mohsin (University of Texas Rio Grande Valley); Robert Maggiani (National Center for Appropriate Technology); Justin Duncan (National Center for Appropriate Technology); Colin Mitchell (National Center for Appropriate Technology)*

Subtropical climates pose special challenges for cover cropping and other soil health improvement strategies because of the intense summer heat, humidity, and lack of killing freezes. Much of the research done in temperate regions simply does not apply to subtropical areas. The Subtropical Soil Health Initiative was a four-year effort to demonstrate ecological soil management in the Rio Grande Valley of South Texas, a region where there has been little locally-relevant research. Adoption rates for cover cropping are extremely low, and dryland producers express concerns that moisture loss to cover crops will harm cash crop yields.

We carried out controlled studies of over 40 cover crops, including some that are common in other subtropical parts of the world but unusual in Texas. We found that sunn hemp, sorghum sudangrass, and cowpea (among others) performed well in hot, humid summer conditions: suppressing weeds, adding biomass, and (in the case of the legumes) adding nitrogen. Among the less common cover crops tested, pigeon pea, clitoria, and velvet bean (mucuna) showed promise, along with some varieties of phaseolus. Soil moisture monitoring partially validated producer concerns about cover crops "stealing moisture" from cash crops. Soil moisture in cover crop plots was lower, on average, than in adjacent control plots during the first two years of the project, but soil organic matter levels and water-holding capacity steadily improved in fields with cover crops. Overall, we found that cover crops represent a risky and delayed return on investment for dryland farmers--with economic returns dependent on weather and the timing of rainfall events. These findings reinforce the importance of conservation cost-share programs like EQIP that reduce the up-front cost and risk to producers.

*Denotes primary author

Poster Number: 22

Title: Undertaking Multi-Species Cover Cropping Demonstrations in North Carolina

Authors: *Alan J. Franzluebbers (USDA-ARS)*; Stephen Broome (North Carolina State University); Katherine Pritchett (North Carolina State University); Michael Wagger (North Carolina State University); Nathan Lowder (USDA-NRCS); Steve Woodruff (USDA-NRCS); Michelle Lovejoy (North Carolina Foundation for Soil and Water Conservation)*

Multi-species cover cropping (i.e. growing several different species of cover crops in the same field at the same time) has been promoted as a top-tier conservation approach for growers that want to improve soil health. However, limited data are available in North Carolina to show how effective the practice might be in establishment, biomass accumulation, and its effects on soil properties. A conservation collaboration was conducted to extend information to growers and assess changes in soil properties from several dozen trials conducted on farmer's fields throughout North Carolina. Trials typically consisted of alternating 40-80 feet wide strips repeated twice in a field. Biomass production was good to excellent in about two-thirds of the trials. Greater nitrogen accumulation in cover crop biomass was possible with multi-species cover crops than typical cereal grains due to significant legume proportion of the mix. Soil biological properties were improved in side-by-side strips of multi-species cover crops compared with no cover crops or single-species cover crops, implying that subsequent cash crops would have greater fertility conditions through supply of bio-available nitrogen and improvement in soil physical properties. This study demonstrated that the majority of growers can successfully grow multi-species cover crops with high biomass production, and that these cover crops can improve soil conditions to create a more resilient agricultural system.

*Denotes primary author

Poster Number: 23

Title: Unlocking the Value of Green Infrastructure Incentive Programs for Urban Agriculture by Leveraging Private and Public Investment

Authors: *Benjamin Shorofsky (Greenprint Partners); Anna Jentz (Greenprint Partners)**

Greenprint Partners (WBE, B-Corp) is a mission-driven green stormwater infrastructure delivery partner. Through a USDA Conservation Innovation Grant (CIG), Greenprint is piloting a green stormwater infrastructure program targeted to urban farmers, and developing a series of best practices to establish a scalable model for cities to co-locate green stormwater infrastructure interventions on their urban agriculture land. Co-locating green stormwater infrastructure practices and urban agriculture operations has the potential to improve water, soil, and energy conservation, create and enhance pollinator habitats, and increase productivity.

To realize this potential and align urban agriculture priorities with green infrastructure co-benefits, Greenprint assembled an Urban Agriculture Advisory Group of urban farmers from across the country. Program design innovation frameworks were employed to conduct surveys, interviews, and facilitated discussions with the group. A review of available GSI programs and their applicability to urban agriculture was also conducted, identifying program characteristics, opportunities, and barriers, as well as case studies. Initial learnings indicate major barriers for urban agriculture practitioners pursuing green infrastructure projects include organizational size and capacity. Customized models for urban farmers should focus on making project activities and maintenance commitments accessible within the constraints of small, volunteer-based organizations and emphasize opportunities for community engagement, environmental education, and stewardship. These learnings will be applied to pilot green stormwater infrastructure for urban agriculture practitioners and have implications for local stormwater utilities and municipal governments.

*Denotes primary author

Conservation Economics and Policy

Poster Number: 24

Title: Ag Retail in Transition: Evaluating a Fee-Based Sustainability Service Model

Authors: *Seth Harden (The Nature Conservancy)**

The Nature Conservancy and The Center for Food and Agricultural Business at Purdue University are collaborating to explore and expand opportunities to develop new fee-based service products that generate income for agriculture retailers and improve profitability through the accelerated adoption of conservation practices by farmers. Our goal is to develop and test a business model for agriculture retailers that builds new income streams from fee-based services and reduces their reliance on product margins to better compete and maintain relevance in supporting the current and future needs of their farmer-customers.

Over the 18 months, Purdue University researchers conducted focus groups with key staff of five agriculture retailers and a corresponding subset of customers. With frames of short and long term profitability, inquiry was concentrated on business planning, conservation services, data management services, and current fee-based services. The primary objective was to discover barriers agriculture retailers are facing in initializing and sustaining product and service offerings directly tied to conservation outcomes, including cover crops, nutrient management planning, and other agronomic prescriptions. Secondary objectives included discovery of agriculture retailer training needs related to conservation adoption, economic research gaps, and the underlying social science.

Opportunities and barriers around agriculture retail's role in conservation promotion that were once assumptions, are now confirmed. Collaboration with agriculture retail, a distributed network of trusted advisers for farmers, is a promising endeavor. This research provides a case for scaling this collaboration and a framework for additional study.

*Denotes primary author

Poster Number: 25

Title: Economics of CP42 Placement in Iowa

Authors: *Haleigh Summers (Iowa State University)*; Emily K Zimmerman (Iowa State University); John Tyndall (Iowa State University); Matthew O'Neal (Iowa State University)*

In Iowa, approximately 1.7 million acres are enrolled in the Conservation Reserve Program (CRP). Pollinator Habitat (CP42) is one conservation plan offered through CRP and is intended to increase the quality and quantity of habitat for pollinating insects. There are currently around 89,000 hectares of CP42 in Iowa. While conservation practice implementation for practices like CP42 continues to grow, the cost of conservation remains a significant deterrent. This research examined opportunities to reduce farm-level financial costs for conservation practice implementation by evaluating subfield profitability and conservation practice placement. We used publicly available data (e.g., soils, CSR2, and land rent) and current CP42 locations to explore the opportunity costs associated with land that is presently in CP42 and the broader field where the conservation practice is contained. We hypothesized that land currently removed from production and in CP42 has lower average opportunity costs than the broader field because areas with lower opportunity costs, and thus likely lower return on investment (ROI) or profitability, may be more likely to be removed from production and placed in conservation. By placing these low-performing hectares into CP42, landowners and farmers can reduce input costs to that area of the field and potentially improve farm profitability. These conservation practices also provide additional environmental benefits. This work will contribute to understanding how conservation practice placement can maximize farm profitability while providing valuable environmental benefits.

*Denotes primary author

Poster Number: 26

Title: Farm-Level Optimization and Sensitivity Analysis of Rice Irrigation Decisions in the Arkansas Delta

Authors: *Thomas P. Dill (Arkansas State University)*; Michele Reba (USDA ARS); Joseph Massey (USDA-ARS Delta Water Management Research Unit); Aaron Shew (University of Arkansas); Lawton Nalley (University of Arkansas); Oladipo Obembe (Arkansas State University)*

Rice grown in Arkansas requires substantial amounts of irrigation water (19-30 acre-inches) which is withdrawn primarily from a shallow alluvial aquifer at unsustainable rates. Accounting for more than half of the rice grown in the United States, rice contributes over $4 billion to the Arkansas economy. To address irrigation concerns, rice producers have begun using surface water sources such as irrigation reservoirs and tail-water recovery systems to offset groundwater reductions. Although there is typically ample rainfall in the winter, surface water and rainfall are less plentiful during the rice growing season. The addition of irrigation reservoirs and tail-water recovery systems allows farmers to capture rainfall and irrigation runoff and recycle it during the growing season when irrigation water is required. In addition to the irrigation source, farmers can irrigate using several management techniques: cascade flood, multiple inlet rice irrigation (MIRI), alternate wetting and drying (AWD), and furrow irrigation, which have important tradeoffs in terms of cost of production, water use, and rice yields. In this study, we examine irrigation decisions for a 2,000-acre example farm with 80-acre fields using linear programming optimization. We investigate profit-maximizing and irrigation minimizing decisions based on water source and management technique with constraints on budget, cost of production, and acreage from extension enterprise budgets. We further conduct a sensitivity analysis on the influence of commodity prices, input costs, and rice yields. Additionally, we include crop rotation decisions for continuous rice and rice-soybeans to determine tradeoffs in profit and groundwater requirements across years. Results from this study will be valuable for on-farm irrigation decisions, extension and consultants making irrigation recommendations, and policymakers who provide government cost-shares for irrigation water management.

*Denotes primary author

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

Poster Number: 27

Title: Soil Carbon and Nitrogen Fractions of Long-Term Farming Systems in the Coastal Plain of North Carolina

Authors: *Alan J. Franzluebbers (USDA-ARS)*; Chris Reberg-Horton (North Carolina State University); Nancy Creamer (North Carolina State University)*

Long-term agricultural experiments are an invaluable resource to better understand how management affects soil conditions, as well as how persistent soil, weather, and management conditions affect productivity, profitability, and environmental quality. Soil organic matter and soil biological activity were determined following 19 years of management, which included conventional row cropping, organic grain production, integrated crop-livestock production, timber production, and successional agricultural abandonment. Conservation agriculture approaches using no tillage, grass-crop rotation, cover cropping, and organic amendments resulted in superior soil attributes (i.e. soil organic C, total soil N, particulate organic C and N, net N mineralization, and soil-test biological activity) for enhancing soil health conditions on a large field-scale experiment in Goldsboro NC. Managed timber and agricultural abandonment improved soil organic C near the soil surface, which allowed significant protection of the soil from erosion and offered opportunities for nutrient retention. However, innovative cropping systems that used rotation of pastures and crops over time and organically managed cropping systems stored more organic matter and allowed greater nutrient availability than other more conventional systems. This information will be valuable for farmers and extension agents to design robust and resilient agricultural management systems in the face of growing threats from climate change.

*Denotes primary author

Conservation Models, Tools, and Technologies

Poster Number: 28

Title: Comparing Ground-Based and Aerial Data at Field Scale during Dry Down on Golf Course Fairways

Authors: *Chase M. Straw (Texas A&M University)*; Joshua Friell (The Toro Company)*

Spatiotemporal data and analyses are gaining traction in the turfgrass industry as valuable tools to enable data-driven management practices, but to date there has been minimal research in practical settings. The objective of this work was to quantify relationships between soil volumetric water content (VWC), proximal normalized difference vegetation index (NDVI), and several aerial measurements (visible, NDVI, and thermal infrared) collected in a real-world application at field scale during a dry down. Data collection surveys were conducted in 2020 the morning of 25 Feb, afternoon of 25 Feb, and morning of 27 Feb on three golf course fairways in CA, USA. The first survey was initiated following an irrigation event, and then no additional irrigation or rainfall occurred prior to the second and third surveys. Ground-based data were collected using the Precision Sense 6000™ and aerial data were collected using an unmanned aerial vehicle. Data were appropriately georeferenced and analyzed to determine correlation between VWC and proximal NDVI, proximal and aerial NDVI, and VWC and aerial measurements. A significant, weak correlation ($r=–0.21$, $p<0.05$) was found between VWC and proximal NDVI measurements, but only for the first survey immediately following the irrigation event. Significant, moderate to strong correlations were found between proximal and aerial NDVI during all three surveys [$r=0.63$ ($p<0.001$), $r=0.64$ ($p<0.001$), and $r=0.85$ ($p<0.001$), respectively]. Volumetric water content was significantly correlated with aerial NDVI measurements ($r=–0.26$, $p<0.001$) and a visible light image that had a peak response at 590 nm ($r=0.13$, $p<0.05$), but these relationships were weak and only existed for the first survey following the irrigation event. This study demonstrates the complexity of scaling remote sensing technologies to real-world applications and identifies several barriers to providing quantitatively predictive and actionable data to turfgrass managers.

*Denotes primary author

Poster Number: 29

Title: Soil Greenhouse Gas Emissions as Affected by Land Management in Missouri River Floodplains

Authors: *Jamshid Ansari (University of Missouri)*; Stephen Anderson (University of Missouri); Morgan Davis (University of Missouri); Frieda Eivazi (Lincoln University); Sougata Bardhan (University of Missouri)*

Concentrations of greenhouse gases (GHG) from anthropogenic and natural sources have increased in recent centuries with numerous potential changes on different natural and managed systems. Changes in land-use systems and management practices (e.g., tillage, fertilizer applications) affect soil microbial organisms and soil organic matter as well as soil GHG emissions. The hydrology of floodplains and their poorly drained soils often result in anaerobic conditions that impact the prevalence of differing soil microbial consortiums affecting soil GHG emissions. GHG (methane, nitrous oxide, and carbon dioxide) emissions were investigated over a growing season (May-October 2020) from three different land-use/land-cover systems: agroforestry (AF), agriculture (AG), and riparian forest (RF) located at the Horticulture and Agroforestry Research Center, New Franklin, Missouri, U.S. Gas samples were collected in a weekly time-period using static chambers. Gas concentrations were measured with a gas chromatography unit. Results revealed that the agroforestry system (AF) has a significantly higher ($p<0.0001$) nitrous oxide (N_2O) emission compared to AG and RF management. There were no significant differences in the case of methane (CH_4) emissions between the three different treatments. RF and AF showed significantly higher ($p<0.0001$) CO_2 emissions than AG. The highest GHG emission happened in June after a flooding event with an average of 224 g N_2O-N/(ha d) and 148 g CH_4-C/(ha d) from the AF treatment, and 77,100 g CO_2-C/(ha d) from RF. Conclusions showed that nitrogen-based fertilizer applications, and higher organic matter in the AF site, contribute to the higher N_2O emissions compared to RF and AG. AG in contrast had not received any nitrogen fertilizer for two years due to soybean cultivation. Higher organic matter and enzyme activity in RF and AF led to higher CO_2 emissions from both sites compared to the AG treatment.

*Denotes primary author

Poster Number: 30

Title: Updating Best Management Practice Nitrogen and Phosphorus Reduction Efficiencies and Assessing Updated Reduction Potentials for Best Management Practices in Iowa Watersheds

Authors: *Chelsea L. Ferrie (Iowa State University)*; Emily K. Zimmerman (Iowa State University)*

To meet the nutrient reduction goals set forth in the Gulf Hypoxia Action Plan, each state in the Mississippi River Basin was mandated to develop state nutrient reduction strategies. The Iowa Nutrient Reduction Strategy (IA NRS) was released in 2013 and set state nonpoint source load reduction targets of 41% of total nitrogen and 29% total phosphorus. A key component of meeting these nonpoint source nutrient reduction targets is the implementation of best management practices (BMPs). This research updated nutrient reduction efficiencies associated with BMPs included in the IA NRS. To do this, we conducted a literature and meta-analysis of recently published research from Iowa and surrounding states. Changes in nutrient reduction efficiencies were marginal for many BMPs. For example, the percent nitrate reduction for bioreactors was updated to 41% from the 43% listed in the IA NRS. We applied these updated nutrient reduction efficiencies using the Agricultural Conservation Planning Framework (ACPF) to assess updated nitrogen and phosphorus reduction potential and costs from select BMPs in case study watersheds in Iowa and assessed variability in nutrient reduction and cost-efficiency over time. Updated nutrient reduction efficiencies, and their application in the ACPF with cost information, provides land and resource managers with updated opportunities to evaluate biophysical and economic outcomes associated with various conservation scenarios.

*Denotes primary author

Poster Number: 31

Title: Utilizing Watershed Models and Tools for Quantifying Environmental Outcomes from Comprehensive Watershed Management Plans in Minnesota

Authors: *Matt Drewitz (BWSR)*; David B. Wall (Minnesota Pollution Control Agency)*

Minnesota (MN) developed a Watershed Management Framework to address the complex watershed management issues. This framework focuses on watershed monitoring, resource characterization, strategy development, planning, and on-the-ground practice implementation. MN has developed watershed restoration and protection strategies and Total Maximum Daily Loads for most major watersheds. MN is incorporating watershed management strategies into comprehensive watershed management plans (CWMPs) to address water quality and quantity issues. The MN Board of Water and Soil Resources (BWSR), through the One Watershed, One Plan program, has been working with soil and water conservation districts, county governments, watershed districts, Tribal governments, and cities to develop CWMPs that prioritize water resources that focuses conservation work that is measurable. The MN Pollution Control Agency (MPCA) has developed HSPF models for most watersheds in the State and then developed HSPF-SAM to provide access of the model outputs to conservationists and watershed scientists who weren't experts using the model. The BWSR also invested in the PTMApp tool, which y provide pollution reduction estimates for conversation practices and potential geospatial locations for those practices. The MPCA and the BWSR have been updating the technology behind these tools, increasing user friendliness, and providing wider access to the models throughout the State. This poster presentation will focus on: Description of the models and linkage to the MN's Watershed Management Framework; cases studies of how these models have been used in the CWMP and implementation process to increase efficiencies in adopting conservation practices; strengths, weaknesses, and limitations of the models; examples of how these models are used to prioritize watershed work and target specific practices for implementation; quantifiable watershed goals developed for CWMPs; and how these models can be used outside of MN.

*Denotes primary author

Poster Number: 32

Title: Watershed Modeling for Assessing the Impact of CREP on Reducing Agricultural Nonpoint Source Pollution

Authors: *Elias Getahun (Prairie Research Institute, University of Illinois Urbana-Champaign)*; Laura Keefer (Illinois State Water Survey, Prairie Research Institute, University of Illinois Urbana-Champaign)*

The Conservation Reserve Enhancement Program (CREP) in Illinois, which is a joint federal-state program, has the goal of improving water quality and wildlife habitat in Illinois and Kaskaskia River basins. Nonpoint source pollution (NPS) resulting from sediment and nutrient runoffs have been the two main causes of water quality and habitat degradations. Therefore, CREP goals were set to reduce sediment loadings to the two rivers by 20%, and nitrogen and phosphorus loadings by 10%. In this study, a hydrologic and water quality model was developed for a CREP monitoring watershed in Illinois River basin, incorporating enrollments for all CREP practices in the watershed. A what-if scenario representing a No-CREP condition that removes all CREP practices and returns the land back to its pre-CREP land use was developed and simulated using the resulting watershed model. The No-CREP simulation results were then compared with that of CREP condition to evaluate the program's effectiveness from 2000 to 2016. Preliminary results indicate that the least NPS load reductions were generally obtained for 2000-2003 period and in contrast, higher reductions of sediment and nutrient loads were exhibited for 2004-2008 and 2009-2016 periods, with some exceptions. Nitrate-nitrogen load reductions were the highest in the fall seasons of 2004-2008. Simulation results also indicate that the CREP practices relatively have the smallest impact on sediment load reduction in the study watershed. For all periods, total phosphorus exhibited the highest load reduction as compared to that of sediment and nitrate-nitrogen loads. This scenario analysis provides useful information that indicates the sediment and nutrient loads prevented from reaching the streams as a result of CREP enrollments in the watershed. The watershed model could further be used to evaluate different best management practices so that comparison be made with current practices for optimal reduction of agricultural NPS pollution.

*Denotes primary author

One World, Connected through Conservation

Poster Number: 33

Title: Application of Geographic Information Systems and Best Management Practices to Identify and Ameliorate Erosion from Unpaved Roads in the US Virgin Islands

Authors: *Jesse Matt (Iowa State University)**

Unpaved roads are a major source of erosion and sedimentation in the US Virgin Islands and Caribbean. Sedimentation can degrade the integrity of coastal ecosystems, which provide valuable environmental, cultural, and economic benefits to local communities. Identifying critical areas and suitable best management practices (BMPs) can mitigate erosion and sedimentation. Vegetative BMPs offer an alternative to pavement- and concrete-based BMPs, and can utilize native species and culturally significant agricultural crops. This research applies a GIS-based framework in small catchments to identify critical areas of potential erosion from unpaved roads and suggest suitable, vegetative BMPs to address areas of erosion. To do this, we used qualitative methods to identify points of intersection for flow accumulation and unpaved roads, and evaluated identified locations for suitability of three different vegetative BMPs based on biophysical characteristics. The three vegetative BMPs were (1) a perennial bunchgrass, *Chrysopogon zizaniodes*, (2) an assemblage of native species, and (3) conucos, which are based on pre-Columbian mound agricultural systems. We illustrate this framework and its potential application in small case study catchments located on St. John, US Virgin Islands. This framework has potential applications throughout the Caribbean Antilles, where steeps slopes, unpaved roads, and increasingly severe storm events facilitate delivery of eroded sediment to coastal ecosystems. This framework can be a tool for resource managers to identify critical areas and examine opportunities to ameliorate erosion concerns with cost-effective vegetative BMPs.

*Denotes primary author

Poster Number: 34

Title: Cacao for Peace Project of Sierra Nevada de Santa Marta, Colombia: A Multifaced Approach to Resource Conservation. Major Findings and Future Perspectives

Authors: *Zamir Libohova (USDA-NRCS)*; Javier Mauricio Martín López (International Center for Tropical Agriculture (CIAT)); Mayesse Aparecida Da Silva (International Center for Tropical Agriculture (CIAT)); Charles Lagoueyte (USDA-NRCS); Janella Cruz (USDA-NRCS); Patrick J. Drohan (Pennsylvania State University); Siela N. Maximova (Pennsylvania State University); Mark Guiltinan (Pennsylvania State University); Giulio Ferruzzi (USDA-NRCS); Daniel Guarin (Pennsylvania State University); Paul Reich (USDA-NRCS); Charles Kome (USDA-NRCS); Yeny Zapata (International Center for Tropical Agriculture (CIAT)); Gerardo Gallego-Sánchez (International Center for Tropical Agriculture (CIAT)); Constanza Quintero (International Center for Tropical Agriculture (CIAT)); Cesar Augusto Botero Vargas (International Center for Tropical Agriculture (CIAT)); Michael Robotham (USDA-NRCS)*

The Cacao for Peace (CfP) Project in Colombia supported by United States Agency for International Development (USAID) is a multi-agency cooperation between the United States Department of Agriculture (USDA), the International Center for Tropical Agriculture (CIAT), Pennsylvania State University, the Foreign Agriculture Service (FAS), the Colombian Cacao Producers Federation (FEDECACAO), and the United Nations Office against Drugs and Crime (UNODC) with the participation of Colombian Government, farmers and local indigenous people. The major goal of the CfP is to increase farmer incomes by increasing cacao yields, improving cacao quality, while persevering natural resources. A survey of soils and cacao plant genomic was conducted by a diverse team of scientist and natural resources specialists from participating agencies and organizations in support of the goals. The project combined traditional and digital methods to identify suitable areas for growing cacao. Some of the major achievements of the project are (i) soil map of soil types and properties at 1:24,000 scale; (ii) cacao suitability maps; (iii) erosion assessment; (iv) compressive database of soil analysis and cacao genomic; and (v) web-based and GIS platform for providing the data and maps to farmers and natural resource planners. Some of the major findings and future perspectives will be presented.

*Denotes primary author

Poster Number: 35

Title: Dynamic Soil Properties: Snapshot in Time for Hanson County, South Dakota

Authors: *Carrie Werkmeister (USDA-NRCS)*; Lance Howe (USDA-NRCS); Steve Winter (USDA-NRCS); Wilfredo Justiniano (USDA-NRCS); Chyenna Julius (USDA-NRCS); Heidi Rients (USDA-NRCS); Nathan Jones (USDA-NRCS); Kent Vlieger (USDA-NRCS)*

The purpose of the South Dakota (SD) Dynamic Soil Properties (DSP) study is to show how different management systems, such as native range vs conservation reserve program (CRP), impact soil properties, such as organic matter (OM) content and microbial activity in a side-by-side evaluation. The DSP design gathers information on how soils are altered through anthropogenic management and how this impacts soil functions (e.g., infiltration, aggregate stability, soil color) within the management system. Understanding these changes is a crucial part in practicing regenerative range and program practice systems across the state. The DSP project provides valuable information to producers allowing them to make better informed decisions regarding long-term management practices. This site is in Hanson County SD, located on the eastern side of the state with Clarno and Hand soils located on upland glacial till/sediments. Three sites were evaluated: 1) native range; 2) 8-year CRP; and 3) 31-year CRP. Overall, there were subtle differences between the DSP locations when comparing the sites as well as varying infiltration rates. Re-evaluations of these sites after 10 years would further provide better understanding of the influence that different management systems can have on DSP.

*Denotes primary author

Social Sciences Informing Conservation

Poster Number: 36

Title: What Do Farmers and Advisors Need from Their Precision Agriculture Tools? An Investigation into Farm Productivity and Conservation

Authors: *Matthew Nowatzke (Iowa State University)**

The increased availability in remote sensing data and precision agriculture tools has made analyzing fields for productivity, profitability, and environmental sustainability a real possibility; however, adoption of tools and decision support systems remains low. A recent review of 61 decision support tool studies found that only 11 incorporated any sort of end-user feedback and of those 11 studies only one conducted a formal assessment of the collected qualitative data, leading to our hypothesis that current decision support systems are not meeting farmer needs via lack of engagement. This study interviewed a combination of farmers, farm managers, and advisors to see how current precision agriculture tools, remote sensing, and decision support systems are currently meeting or failing end-user needs. The findings will be made available as a resource to inform the feature sets of future systems, hopefully leading to better tools, more productive farms, and protection of the environment.

*Denotes primary author

Soil Health Resources, Indicators, Assessment, and Management

Poster Number: 37

Title: Relating Soil Health Indicators to Edge-Of-Field Water Quality in Ohio

Authors: *William Osterholz (USDA ARS)**

Soil health and water quality are two major goals of agricultural management systems, but the complementarity of these goals is an outstanding question as the relationships between soil health indicators and water quality outcomes remain unclear. In this study we explore the direct relationships between a suite of soil characteristics (including soil health indicators) and edge-of-field (EoF) water quality. We utilized a network of fields in Ohio that have been monitored for EoF water quality and assessed for soil characteristics including typical agronomic tests and soil health indicators. Relationships between the field average soil characteristics and tile drainage and surface runoff discharge and loads of dissolved reactive P, total P, and nitrate will be explored with random forest and multiple linear regression approaches. Connections between soil and field characteristics and water quality outcomes will be highlighted. Particular attention will be given to relationships between the water quality outcomes and the soil health indicators. These results will provide initial insights into the complementarity or antagonism between the goals of soil health and water quality in the context of Ohio agriculture.

*Denotes primary author

Poster Number: 38

Title: Soil Health Education for High School Youth

Authors: *Natalie J. Carroll (Purdue University)**

The presentation will show a new online resource for high school teachers. A 2015 survey of high school (n=46) agricultural teachers in 2015 revealed that 73% currently address “healthy soils” and 100% would teach more about the topic if they had suitable instructional materials. Our goal for this curriculum is to increase soil health knowledge to promote soil-friendly farming practices leading to improved environmental quality, sustainability and increased farm efficiency. The target audiences for the website (www.Purdue.edu/SoilHealth) are teachers and high school aged youth, Extension Educators, and other agricultural professionals. Developed with funding from the USDA SARE program, the website draws on and consolidates educational activities, videos, and other resources from Purdue Extension and the Natural Resource Conservation Service.

The curriculum is presented in two categories: Soil Basics for those who do not have a fundamental knowledge of soil properties and Soil Health for the more complex interactions of soil, water, farming practices, economics, and other issues.

*Denotes primary author

Poster Number: 39

Title: Updating Permanganate Oxidizable Carbon Instruction of On-Site Dynamic Soil Property Kit

Authors: *Ekundayo Adeleke (USDA-NRCS-NSSC)*; Diane Hooper (USDA-NRCS-NSSC); Kathy Newman (USDA-NRCS-NSSC); Skye Wills (USDA-NRCS)*

Permanganate oxidizable carbon (POXC) is a quick and effective field test to assess the fraction of the soil organic carbon (SOC) that is oxidizable by the potassium permanganate ($KMnO_4$) solution. This fraction of SOC (also referred to as active carbon) is responsive to land management changes. The existing POXC test for the field office requires an update to generate optimum data. In this study, we improved the instruction by emphasizing that soil samples be sieved to ≤2 mm, reduced the soil samples to 2.5 g, and increased the kit's capacity. We calibrated the optimum test performance with soil standards - Olney loamy sand, Kennebec silty loam and Wymore silty clay loam having SOC content of 0.26, 2.66, 3.3 respectively. The results showed no significant difference between the mean values obtained with the POXC kit and the values obtained using laboratory determined method. The mean value of the sample was not significantly different between replicates. However, POXC kit showed significant differences among all samples (Olney loamy sand < Kennebec silty loam < Wymore silty clay loam). This result indicates the test kit's ability to determine changes in active carbon. Expanded distribution of the POXC kits will allow soil survey to include POXC measurements in dynamic soil property and Soil Health Assessment projects.

*Denotes primary author

Water Resource Assessment and Management

Poster Number: 40

Title: Adsorption of Fluorescent Labeled E. Coli as Affected by Selected Conservation Buffer Systems

Authors: *Nasruddeen Al-Awwal (University of Missouri)*; Stephen Anderson (University of Missouri); Majed El-Dweik (Lincoln University)*

The magnitude of bacterial transport by runoff into surface water and infiltration into groundwater is influenced by adsorption processes in soil. This project evaluated bacterial adsorption to soil from three land treatments: grass buffer, agroforestry buffer and row crop management. The objective was to determine which treatments can mitigate E. coli transport to water. Soil samples were collected from the University of Missouri Greenley Research Center, Novelty, Missouri. Equilibrium desorption studies were conducted in the laboratory. MALDI Biotyper was used for the screen tests of the soil from the treatments. Results showed that native bacterial organisms in the soils were found to be *Bacillus cereus*, *Citrobacter freundii*, and *Aeromonas veronii* for the grass buffer, *Lysinibacillus fusiformis* and *Bacillus pumilus* for the agroforestry buffer, and *Acinetobacter pittii* and *Lysinibacillus pakistanensis* for the row crop treatment. Initial results potentially show that conservation buffers assist in reducing bacterial transport to water resources.

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Poster Number: 41

Title: Automation of Rice Irrigation

Authors: *Thais Jardim (Arkansas State University)*; Joseph Massey (USDA-ARS Delta Water Management Research Unit); Michele Reba (University of Memphis); Arlene Adviento-Borbe (USDA-ARS Delta Water Management Research Unit); Ahmed Hashem (Arkansas State University)*

Efficient irrigation methods are needed to minimize economic and ecological issues linked to aquifer overdraft in the Lower Mississippi River Basin (LMRB). Additionally, LMRB producers are farming larger areas, often with the same labor and management strategies used in the past. Irrigation technology may help producer's address both aquifer decline and labor shortages. This research compared four levels of irrigation automation to determine which are most helpful to producers. Automation was studied on sixteen 16-ha fields, four using multiple-inlet rice irrigation (MIRI) and 12 using furrow-irrigated rice (ROW). The automation levels were: Manual (manual on/manual off); Timer-Off (manual on/timer off), Informed-On (text message-manual on/timer off), and Full-Auto (auto on/auto off). Irrigation timing and duration was managed based on water depth as measured in one PVC field-tube installed per field. The tubes were equipped with an ultrasonic sensor (Full-Auto & Informed-On) or a manual flood depth gauge (Manual & Timer-Off). Grain yield, irrigation water applied, and irrigation water use efficiency (IWUE) were determined. Preliminary results from irrigation applied by each automation level suggest that Timer-Off and Informed-On provide the highest IWUE values of 29.7 and 31.7 kg ha^{-1} mm^{-1}, respectively. Averaged across all automation levels, MIRI produced 28 kg grain ha^{-1} mm^{-1} compared to 25 kg grain ha^{-1} mm^{-1} for ROW. The field-tube is a simple, reliable method for determining when to start irrigation. However, the rapid rewetting rate of soil in the tube does not allow accurate prediction as when to stop irrigation. Thus, a pump timer rather than field-tube proved most helpful in automating pump shutoff. These results also show that full automation of rice irrigation is now possible with the pump control system taking full control of four fields. Economic comparisons of the four automation levels will begin after these on-farm studies are repeated in 2021.

*Denotes primary author

Poster Number: 42

Title: Do Patterns in Water Quality Impairment of Small Agricultural Streams Change as Spatial Resolution of Sampling Changes?

Authors: *Alyssa C. Gerhardt (Drake University)*; Natalie Griffiths (Oak Ridge National Laboratory); Peter Levi (Drake University); Jeff Riggs (Oak Ridge National Laboratory); Chris DeRolph (Oak Ridge National Laboratory); Allison Fortner (Oak Ridge National Laboratory)*

The Midwestern (U.S.A.) landscape is generally homogeneous with a high proportion of area in agricultural production. As a result, many streams and rivers in the Midwestern U.S.A. have impaired water quality. However, the waterways that drain predominantly agricultural landscapes may have more heterogeneity in their impairment despite the homogeneous landscape surrounding them. Novel methods, such as the use of an unmanned surface vehicle (USV) to monitor water quality, can offer insight into within-stream variability that is not available through in-stream sensor networks or field sampling. We sought to quantify the heterogeneity of water chemistry in a headwater stream in an agricultural watershed. Furthermore, we examined whether the patterns in these parameters changed as spatial resolution changed. We collected stream water nitrate and conductivity using multiple methods in a 2.1-km reach of Alleman Creek in Central Iowa. For the highest resolution data, we deployed a USV equipped with a multiparameter sonde and nitrate sensor for two runs in June 2020. Second, we collected grab samples every 100m twice during July 2020. Finally, at the lowest spatial resolution of sampling, we collected field samples at the top and bottom of the reach biweekly since June 2020. Based on data we have collected so far, the higher spatial resolution from the USV revealed more within-stream variability than single or multi-point grab sampling. We will continue to run the USV down Alleman Creek on a bi-weekly basis. We will also apply this sampling regime to the nearby Fourmile Creek upstream where they are of similar size, and downstream where the creek widens.

*Denotes primary author

Poster Number: 43

Title: Geochemical Impacts of Infiltration Galleries on Groundwater Quality in a Critical Groundwater Area in Northeastern Arkansas

Authors: *Alex Sharp (University of Memphis)*; Deborah Leslie (University of Memphis); Dan Larsen (University of Memphis); Michele Reba (University of Memphis)*

The Mississippi River Valley alluvial (MRVA) aquifer is the primary water source for crop irrigation in the Lower Mississippi River Basin. The economic importance placed on agriculture in Arkansas has resulted in the over-draft of the MRVA. Certain areas in Arkansas have been designated as critical groundwater areas. Managed aquifer recharge (MAR) methods replenish stressed groundwater resources to improve or sustain groundwater quantity and quality. Infiltration galleries (IG) are being investigated as a MAR strategy for improving the resiliency of groundwater resources in northeastern Arkansas. These IG are gravel-filled trenches excavated into the upper unsaturated MRVA sand. On-farm storage reservoir water serves as the recharge water source. Water will move through the IG trench and the unsaturated zone, where downward percolation will provide natural treatment through a sand filter by removing sediment and other particles. Understanding potential chemical reactions and changes in water quality is important in considering risks that could occur upon mixing of the oxygenated surface water with local groundwater. The leaching of trace metals found within the aquifer, such as arsenic and iron, is of concern. This study compares local groundwater and reservoir water quality to identify general trends in water chemistry and potential mineral phases. Sediment grain-size analysis will provide information on the effects of soil type on soil moisture. X-ray diffraction of MRVA sediment will identify clay mineralogy that pose risk for reducing infiltration rates and inducing reactions along the flow path. Geochemical modeling will also be used to anticipate changes in groundwater quality due to mineral precipitation and metal mobilization that are commonly associated with surface water-groundwater interactions. Results will also be considered with the goal of protecting existing groundwater conditions and developing improved infiltration gallery design and monitoring.

*Denotes primary author

Poster Number: 44

Title: Managed Aquifer Recharge: Installation and Feasibility of Two Infiltration Galleries in Northeast Arkansas

Authors: *Allegra C. Pieri (Arkansas State University)*; Michele Reba (University of Memphis); Deborah Leslie (University of Memphis); Joseph Massey (USDA-ARS Delta Water Management Research Unit); Ian A Godwin (Arkansas State University)*

Arkansas ranks third in the nation for irrigated land, with irrigation water being primarily sourced from the Mississippi River Valley alluvial (MRVA) aquifer. Extensive irrigation along with the region's geology have led to the designation of critical groundwater areas. Managed aquifer recharge (MAR) refers to a suite of methods used to intentionally replenish groundwater systems, with a focus on increasing groundwater availability while sustaining or improving quality. This project evaluates the utility of MAR using infiltration galleries (IG) in the Cache River Critical Groundwater Area of northeast Arkansas. IG are gravel-filled trenches excavated to the permeable sand layer of the upper MRVA, with subsurface plumbing connected to a recharge source. Recharge water will be sourced from a nearby on-farm storage reservoir. IG construction began in November 2020. Initial infiltration rates within the upper MRVA were measured using the Encased Falling Head Procedure and ranged from 15.4 cm hr^{-1} to 76.5 cm hr^{-1}. Soil samples were also taken at various depths to describe soil texture and permeability. Once operational, injected reservoir water will infiltrate through the gravel fill and 30 m of unsaturated MRVA sand before reaching the water table. Physical flow measurements, water chemistry, and water table elevation will be monitored throughout the injection period and flow path to estimate recharge rates and track water movement. Results from soil analyses and infiltration tests along with the construction procedure will be presented in the context of infiltration capacity and changes in groundwater storage. Source water quality analyses of suspended solids and temperature will be used to anticipate chemical and physical clogging risks which could eventually lead to lower IG infiltration rates. This study aims to provide on-farm verification of a MAR strategy using IG to identify areas for improvements in design, monitoring, and hydraulic function.

*Denotes primary author

Poster Number: 45

Title: 10-Year Study of Land Use Impact on Drainage Volume in Central Iowa

Authors: *Jennifer Seth (Iowa State University)*; Matthew Helmers (Iowa State University)*

Nitrate loss via drainage from corn/soybean agriculture in the U.S. Midwest has drastically altered the biogeochemistry of the Mississippi River Basin relative to the perennial prairie these crops replace. Prior research posits that perennial systems lose 90-95% less NO_3 via drainage than annual crops like corn and soybean, but one area of question that remains is how hydrology, in addition to chemistry, differs between annual and perennial plant landscapes. Thus, our study quantifies the drainage volume and drainage rate of perennial prairie systems in comparison to traditional cropping systems, such as corn or soybeans, over a 10-year time scale that captures the impacts of variable precipitation. The Comparison of Biofuel Systems (COBS) experiment in Central Iowa has 6 treatments: continuous corn, corn, soybean, corn with winter rye cover crop, prairie with fertilizer, and prairie without fertilizer. We observed drainage flow and precipitation at COBS from 2009-2019 and compiled the data from these years to analyze cumulative drainage and precipitation. We then classified each year as either wet or dry based on deviation from climatological precipitation averages from the Iowa Environmental Mesonet. We compared cumulative and annual drainage across treatments and relative to precipitation. We have found that the corn and soybean systems had the highest cumulative drainage over the 10-year timescale, while the prairie treatment without fertilizer had the lowest cumulative drainage. This experiment suggests that perennial prairie released less water downstream relative to the annual corn/soybean systems that dominate the Midwestern landscape today.

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