WATER CURRENT

NEBRASKA WATER CENTER
PART OF THE DAUGHERTY WATER FOR FOOD GLOBAL INSTITUTE AT THE UNIVERSITY OF NEBRASKA

FALL 2024

Core Research, Events, and News from the Nebraska Water Center

PhD Student Chandan Kumar is collecting soil pore water samples to study reactive nitrogen transformation in the vadose zone.

Inside

And More!

From the Director

Chittaranjan Ray, Ph.D., P.E.

Director, Nebraska Water Center (NWC)

Dear Reader,

Fall at the Nebraska Water Center means campus is full once again and we can continue our work with faculty, students, and partners across the state. In this issue of the Water Current I am glad to share updates on research, extension, and outreach from the Nebraska Water Center.

Work is continuing in soil health (page 7), crop modeling (page 8), critical zone research (page 9), and bioplastics with regenerative agricultural properties (page 10). Fall brings the announcement of projects receiving funding from the U.S. Geological Survey's (USGS) 104b program, which provides research funding for water centers in each state. The Nebraska projects that received 104b funding this year are listed on page 4. The USGS also holds a nationally competitive 104g funding program each year and I am glad to share Nebraska has once again received one of these highly competitive grants. Congratulations to PI Abia Katimbo and Co-PIs Sahila Beegum, Daniel Snow, Sorab Panday, Arindam Malakar, and Alakananda Mitra for their project on connecting crop, groundwater, and vadose zone models for regional use.

In terms of extension, Nebraska is part of a multi-state effort to bring Master Irrigator curriculum to producers across the region. Master Irrigator is intended to improve water use efficiency through educational programs. An update on the Master Irrigator program is provided on page 5.

We recently held our 2024 Nebraska Water Conference and enjoyed connecting with many of you at that event. You can view photos and an overview of the conference on page 6.

Finally, I would like to invite you to join us in Arizona this February for our 2025 Water and Natural Resources tour. Alongside our long-time partner Central Nebraska Public Power and Irrigation District, we are excited to bring you another tour outside our state to learn more about water and natural resources in other parts of the country. Additional details can be found on the following page.

As this will be our last Water Current of the year, I would like to wish you and your family a happy holiday season. We look forward to connecting with you again in the new year.

This newsletter is published with partial financial support from the Department of the Interior; U.S. Geological Survey. The content does not necessarily reflect the views and policies of the Department of the Interior, nor does mention of trade names or commercial products constitute endorsement by the U.S. Government.

Director
Chittaranjan Ray, Ph.D., P.E.

Director of Laboratory Services
Water Sciences Laboratory
Daniel D. Snow, Ph.D.

Cover Photo Credit
David Munyaneza, DWFI

Editor
Ann Briggs
Editorial Assistants: Patricia Liedle and Crystal Powers

Designer
Ann Briggs

Nebraska Water Center
Daugherty Water for Food Global Institute at the University of Nebraska
2021 Transformation Drive, Suite 3220
P.O. Box 886204
Lincoln, NE 68588-6204
Phone: (402) 472-3305
e-mail: waterinfo@unl.edu

NebrWaterCenter NebraskaWaterCenter watercenter.unl.edu

Water and Natural Resources Tour to visit Arizona in February

Save the date for the next Water and Natural Resources Tour, held in Arizona on February 2-7, 2025. Join the Nebraska Water Center and Central Nebraska Public Power and Irrigation District as we experience urban water management, winter agriculture, and transboundary aquifer management. We'll learn from experts in Phoenix, Maricopa, and Yuma and see first-hand how water and natural resources are managed in Arizona.

The tour will begin in Phoenix, Arizona, where we'll spend a day and a half learning about urban water management, wastewater treatment, and natural resource management in desert cities. We will then spend a day and a half in Maricopa, Arizona. Hosted by the USDA's Arid Land Agricultural Research Center, we will visit tribal farming operations and meet with researchers to discuss new findings in desert water management. We will wrap up the tour in Yuma, Arizona. Hosted by the Yuma Center of Excellence for Desert Agriculture and the Yuma County Agricultural Water Coalition, we will experience winter vegetable production and learn how Colorado River water management is crucial to our country's food security.

Tour seats are limited and registration will be open soon. For more information and to register for the tour, visit **go.unl.edu/watertour**.

U.S. Geological Survey grants support Nebraska-based research projects

By Ann Briggs, Public Relations and Engagement Coordinator

Each year, the Nebraska Water Center provides grant funding for research through the U.S. Geological Survey's 104b program. 104b awards are geared towards early-career faculty who are conducting research in Nebraska that has unique applications both within and outside of the state. In 2024, a total of $75,249.00 was awarded. Awards were granted to the following four projects:

Grassroots Conservation: Engaging Communities in WaterSmart Lawn Care Practices. *PI Wei-zhen Liang and co-PI Xin Qiao.* $19,374

The "Grassroots Conservation" project addresses the critical issue of water overuse in residential lawn care, particularly in areas prone to drought. This initiative, centered in Nebraska, aims to develop and deploy an affordable, automatic soil moisture sensing (SMS) system coupled with a comprehensive website platform for real-time soil moisture monitoring. The project seeks to provide continuous data on soil moisture levels to encourage water-smart lawn maintenance. Objectives include assessing technology adoption behaviors among homeowners, promoting sustainable lawn care practices through educational workshops, and involving University of Nebraska-Lincoln (UNL) and Western Nebraska Community College (WNCC) students in experiential learning opportunities. Expected outcomes encompass enhanced water conservation, STEM education integration, and groundwork for future initiatives in sustainable water use. This multifaceted approach aims not only to improve immediate water management practices but also to educate a generation equipped to address the challenges of sustainable water usage, with deliverables including scholarly publications and foundational foundation for future proposal development, e.g., Nebraska Environmental Trust (NET) and NSF-ExLENT.

Monitoring Monthly Groundwater Level Variation in the Nebraska Sandhills using Remote Sensing. *PI Nawaraj Shrestha, co-PIs Troy Gilmore, Aaron Mittelstet, Aaron Young, and R.M. Joeckel.* $14,716

Variations in groundwater levels are frequently estimated using hydraulic heads measured in observation wells. Groundwater levels estimated from sparsely distributed observation wells produce uncertain estimates at unsampled locations that can be highly problematic for groundwater management. In areas where surface water and groundwater intersect, remote sensing provides reliable estimates of hydraulic heads. We propose the application of satellite light detection and ranging (LiDAR) to measure the water levels of lakes in the Nebraska Sand Hills (NSH), a landscape sensitive to climate change, and critical for regional groundwater recharge. Through these measurements, we can closely estimate the local elevation of groundwater and derive a much-improved understanding of groundwater-level change. The research uses hundreds of shallow, interdune lakes that intersect with the regional unconfined aquifer in the NSH. Our proposed research builds upon a previous study demonstrating efficacy of aerial LiDAR for estimating groundwater levels through lake levels in the NSH. We will test the feasibility of monthly groundwater-level estimated using repeated observations from Global Ecosystem Dynamics Investigation (GEDI) and Ice, Cloud, and land Elevation Satellite 2 (ICESat-2). Our estimates will provide the most precise basis for monitoring groundwater levels and unparalleled assessment of spatial variation. Our proposal portends a dramatic increase in the efficacy of decision-making that is highly beneficial to society and the environment.

Growing Groundwater Science. *PI Chris Huber, co-PI Daniel Snow.* $11,358

Domestic well water is vulnerable to contamination from anthropogenic and geogenic contaminants such as nitrate and arsenic. Few are regularly tested, even fewer are tested for the presence of arsenic species. A growing youth-led citizen and community science program promises to elevate the issue of domestic well water quality and provide additional motivation for regular well water quality testing in Nebraska. Undergraduate students at a 4-year southeast Nebraska university will be trained in well water testing, and work with a local high school to properly sample and test domestic wells from the surrounding area. Students will learn how hydrogeology and land use all affect domestic well water quality and communicate results to local stakeholders. Highschool students will compare their measurements to the conventional laboratory measurements, while undergraduate students will compare arsenic test kit results to advanced instrumental methods, quantify atrazine and other pesticides, and evaluate hazards associated with consumption of untreated well water. This project will build on USGS research aimed at understanding temporal and regional changes in US drinking water supplies.

Is Fish Tissue Methylmercury Related to Lake Sediment Methylmercury? *PI Chad Brassil, co-PIs Karrie Weber and Matthew Larrey.* $29,801

Mercury, a highly toxic metal, causes impairments to the vast majority of lakes and reservoirs in the US, and therefore impacts both recreational angling and subsistence food security for many Americans. Mercury cannot enter into aquatic food webs until it is methylated, a process mediated by the microbial community found in anoxic lake sediment. The relationship between sediment mercury and fish tissue methylmercury (MeHg hereafter) has been investigated in other regions of the US. This relationship has often been found to be weak and overshadowed by variables such as sediment and vegetation types unique to each region. The Western Corn Belt region sediment and vegetation types differ from the other regions of the US in which this relationship has been studied, so it represents a gap in knowledge of environmental mercury dynamics. We will measure sediment MeHg in lakes and reservoirs across the Western Corn Belt ecoregion of the Midwest and compare MeHg concentrations within the sediment to concentrations within fishes in those same water bodies. We will also compare sediment MeHg to biotic and abiotic variables to detect significant relationships. Lastly, we will identify the members of the microbiotic community present in those sediments to determine if there is a relationship between certain taxonomic groups and sediment MeHg. Through direct analysis of this key step in mercury movement into aquatic food webs, we will inform fish consumption decisions and advisory practices.

In addition to the state-awarded 104b funds, the USGS holds a nationally competitive grant application for 104g funding. 104g awards are asked to tackle projects that align with the national research priorities of the USGS. In 2024, only six projects were awarded throughout the country. Nebraska received funding for one of these six 104g awards.

Physics-Based Crop, Soil, and Groundwater Modeling of Nitrate Transport to Understand and Manage Groundwater Contamination in Agricultural Regions. *PI Abia Katimbo, co-PIs Sahila Beegum, Daniel Snow, Chittaranjan Ray, Sorab Panday, Arindam Malakar, Alakananda Mitra.* $310,000

Nitrate (N) contamination in groundwater is an escalating issue that poses serious health risks, particularly in areas where groundwater is the primary drinking water source. Over one-third of the US population relies on groundwater for drinking water. However, the quality and safety of drinking water from private domestic wells are not regulated by the federal government or most state governments, creating a significant concern. Nitrate contamination in drinking water is more prevalent in agricultural regions where fertilizers are heavily used. Fertilizers cannot be banned since the rural economy and livelihood depend on agriculture. Instead, effective management strategies aimed at reducing groundwater contamination need to be explored. Such strategies must consider crop N uptake, root- and vadose-zone losses, and transport and transformation within the vadose zone and groundwater. Conventional ways currently used to modify/adjust strategies require vadose zone N data collection, which is cost-prohibitive due to the expense of soil sampling and commercial laboratory analysis. Thus, modeling might be the best option. One available model, USGS's MODFLOW, is excellent for groundwater modeling but does not include N transport and transformation in the vadose zone. Furthermore, an earlier USGS farm process model (FMP) attempted to incorporate farm management practices but fell short in detailing management and estimating crop nitrogen uptake. This project proposes to develop an integrated model to understand N dynamics (including crop N uptake and N leaching) by coupling two models – a modified MODFLOW6 currently enhanced to have 3D vadose zone flow and transport capabilities using a USGS grant awarded to the University of Nebraska-Lincoln and USDA's 2D-SOIL-based crop models with 2D finite element formulation, which lacks a 3-D groundwater component. Insights from the model simulation will help identify N management strategies and develop N recommendations/policies for conservation agencies.

Nebraska Master Irrigator Launch

By Crystal Powers, Water Extension Educator

Groundwater is critical for agriculture across the High Plains. Several states have started programs focused on leading innovation in irrigated farming to preserve the use of groundwater for agriculture into the future. Nebraska is working with partners across the other High Plains Ogallala Aquifer states to expand Master Irrigator and Testing Ag Performance Solutions (TAPS).

The success of these programs has been allowing the focus to be farmer-driven, connecting the latest agriculture technology with practical experience, and connecting farmers, ag business, and natural resource agencies in a pursuit of excellence. Nebraska Water Center Extension Educator Crystal Powers is coordinating Nebraska Master Irrigator and hosted Master Irrigator partners from across eight states in North Platte this fall. The focus was sharing lessons learned from the program so far and finding opportunities to work together for greater impact.

Master Irrigator partners from eight states met in North Platte this fall to discuss future opportunities to work together.

Nebraska is looking forward to bringing together an elite cohort of farmers interested in taking their irrigated farmland to the next level. In winter 2025, we'll be hosting a series of regional Master Irrigator kickoffs. You will hear takeaways from growers who competed in TAPS, connect with the latest tech companies, and attendees will provide leadership on developing Nebraska Master Irrigator. Some of the themes are how to level up your irrigation and soil (including discussion on nitrogen & carbon incentives), navigating agriculture and water policy, and running your farm like a CEO.

Master Irrigator is partially sponsored by a multi-state NRCS Technical Agreement. If you would like to learn more contact **cpowers2@unl.edu**.

Join us for one of the kickoff days to help lead the direction of Nebraska Master Irrigator

North Platte February 12 Central City February 13 Beatrice February 26 O'Neill March 4 Scottsbluff March 6

2024 Nebraska Water Conference

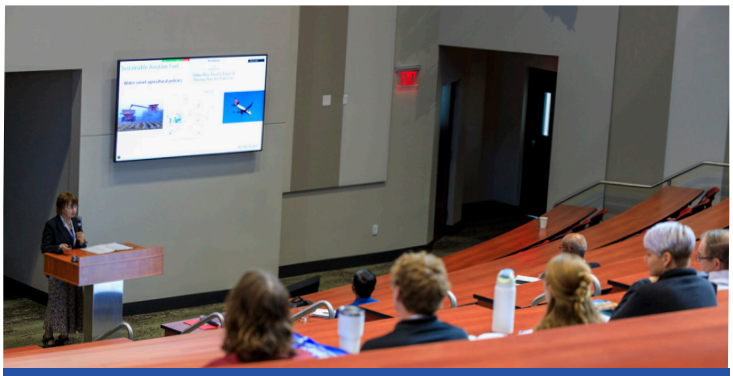
The Nebraska Water Center hosted the annual Nebraska Water Conference in Lincoln on October 9 and 10, 2024. The 2024 conference theme was “Collaboration and Innovation in Nebraska Water.”

Held at the Nebraska Innovation Campus conference center, this two-day event featured discussions on emerging contaminants, drought preparedness, nutrient management, climate smart practices, water and climate resilience, and modeling. Experts from the state and region shared their work and led discussions on future opportunities for innovative partnerships.

Each day offered breakout sessions where attendees had the opportunity to interact with session speakers through Q&A’s and networking. The conference also included student research poster sessions where students competed for a cash prize followed by a reception where the poster competition winners were announced.

160 people attended the conference, coming from five states and representing researchers, policy makers, students, stakeholders, and partners.

As part of the Climate and Water Resilience session, Robert Laroco presented the Omaha Climate Plan.



Bridget Scanlon from the University of Texas at Austin discussed water management in the context of climate extremes.

Rachael Whitehair (left) and Alexa Davis presented on the Nebraska Strategic Ag Coalition.

Seventeen graduate students from the University of Nebraska – Lincoln and the University of Nebraska Omaha presented their research posters to conference attendees and a panel of judges. Posters were presented on tools for water management, climate smart practices, water and climate resilience, water quality, and more.

Greici Parisoto (second from left) received third place for her poster titled, “Temporal Analysis and Trend Impacts of Extreme Events on Brazilian Soybean Production.” Kaitlin Steinauer (middle) received second place for her research, “Repeated Gravity Surveys to Track Seasonal Groundwater Level Variations in Nebraska.” First place was awarded to Rintu Sen (second from right) for “Using the DSSAT CERED-Maize Model to Evaluate Farmers’ Irrigation Decisions.”

UNL Panhandle Research Team introduces new soil health concept

By Ann Briggs, Public Relations and Engagement Coordinator

Researchers at the University of Nebraska's Panhandle Research, Extension, and Education Center are combining their expertise in soil health with the unique landscape of western Nebraska to make strides in soil health research. Bijesh Maharjan, Associate Professor and Extension Specialist in Soil and Nutrient Management, and his team coined the term 'Soil Health Gap' to create a benchmark for soil health that is unique for each field. We sat down with Bijesh to understand how the soil health gap impacts climate smart agriculture in Nebraska and beyond.

How did the concept of a soil health gap come about?

Bijesh Maharjan, Associate Professor and Extension Specialist

In 2020, my team published a concept called 'Soil Health Gap'. The idea behind that concept was, like with any measurement, you first need to know what the unit is. After you have agreed on a unit, I thought there should be a benchmark. Take the meter for example. We all have to agree how long a meter is before we can start talking about other measurements of length. Benchmarking is so important to make sense of any measurement, and with the soil health movement growing so fast I felt that there's no benchmark for these measurements. People can just give a number, but what does that number mean? So we proposed this concept called soil health gap, which asks you to measure soil health in your managed land, such as crop land, and compare it with the native land in your surrounding area. So you can at least compare the ground where humans have been managing for years versus land that nobody has gone there and mixed up the soil. By seeing the difference in those numbers, you get some idea of how much the health of your soil has deteriorated as you manage the ground. Since we started cultivating, most likely the soil health has deteriorated. By comparing the soil health in your cropland against the natural state of land, you know how far you have come away and you can find what should be your target as you manage the ground to improve your soil health.

How do we measure a soil health gap?

There are all kinds of soil, physical, chemical, and biological measurements that give you the inference of soil health status of the ground. So you pick one of your interests or one that reflects your resource constraints, let's say soil organic carbon. You would measure the soil organic carbon in your managed cropland and compare the data to native ground that is close by. What the soil health gap shows is the difference of soil organic carbon in the native ground and the cropland, telling you how much soil organic carbon has been lost and giving you a target for the amount of soil organic carbon it is reasonable to try to reach.

If I were a producer in Nebraska and wanted to figure out what my soil health gap is, what would I do?

We have been working with the Natural Resources Conservation Service (NRCS) to create an interactive map that shows the soil health of native, untouched lands across the state. We're currently collecting samples to gather the data for that map. Once the map is ready and available online, producers will just have to locate which reference site is closest to their cropland to see what the soil health gap is. Until that map is ready, producers can contact their local NRCS office to find out about opportunities for soil health testing and what kind of native, untouched lands have already been tested in their part of the state. If I am not wrong, NRCS provides support to sample native grounds to help you determine soil health gap in your cropland.

What kind of impact has your soil health gap concept had so far?

Research wise, I would say it has been a success. The paper that introduced the concept has been cited close to 100 times so far, which in our field is pretty significant to show that other people have been using this concept in other places to benchmark the soil health management they're doing or further the science of soil health. The whole idea of this concept is to help drive this science of soil health in the right direction. By putting some reference and benchmark to the soil health measurements, you can use it to inform your management decisions. I do feel this concept provides a significant contribution to the science of soil health. We want the science to be more subjective, informative, and applicable. By implementing the soil health gap concept, you can know in your natural agroecosystem what the measurement could be versus what you're seeing in your managed cropland and make management decisions to move back towards that natural level for soil organic carbon and other indicators of soil health.

With a prominent Oregon Trail landmark as the backdrop, a team of researchers and scientists from the USDA Natural Resources Conservation Service and Dr. Maharjan's team at the University of Nebraska-Lincoln participated in an effort to determine and catalog soil health properties in a native, undisturbed soil site for use in the Soil Health Gap project.

Ongoing Research at the Nebraska Water Center

The Nebraska Water Center researchers have several ongoing research projects. In the following pages, a few of our researchers have shared updates on their work in crop modeling (page 8), critical zone research (page 9), and a multistate bioplastic project (page 11).

Continuing to Improve Process-Based Crop Models: A Collaboration Between the Nebraska Water Center and the United States Department of Agriculture's Agricultural Research Service

By Sahila Beegum, NWC Research Assistant Professor

Sahila Beegum and Alakananda Mitra, Research Assistant Professors at NWC, and Aditya Kapoor, Postdoctoral Research Associate at NWC, closely collaborate with USDA ARS Adaptive Cropping Systems Laboratory (USDA ARS ACSL). Since 2021, this collaboration has consistently improved the process-based crop models developed jointly by USDA ARS ACSL and NWC. Recent improvements and updates include incorporating greenhouse gas (GHG) emission modeling, yield quality modeling, AI-based crop models, biogeochemistry integration, graphical interface development, and crop modeling training.

The crop models have been upgraded to simulate gas production and transport mechanisms and are now integrated with GHG emissions routines for carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions. A recent publication in the European Journal of Agronomy evaluated the CO_2 model in a soybean-maize ecosystem under present and future climatic conditions. The study found that climate change will lead to a long-term decline in soil organic carbon, but increased CO_2 could offset this loss. The N_2O simulation in the model has also been improved and is currently being tested with measured data. The group is now working to incorporate a methane (CH_4) emission routine.

Another focus is the integration of AI into crop models. Using extensive field data and process-based model-generated data, the group developed a Random Forest (RF) regressor-based model. This study, published in IEEE Access, demonstrates the applicability of machine learning models to climate-smart agriculture. The algorithm, initially developed for cotton models, is being expanded to develop an AI-based model for corn simulation.

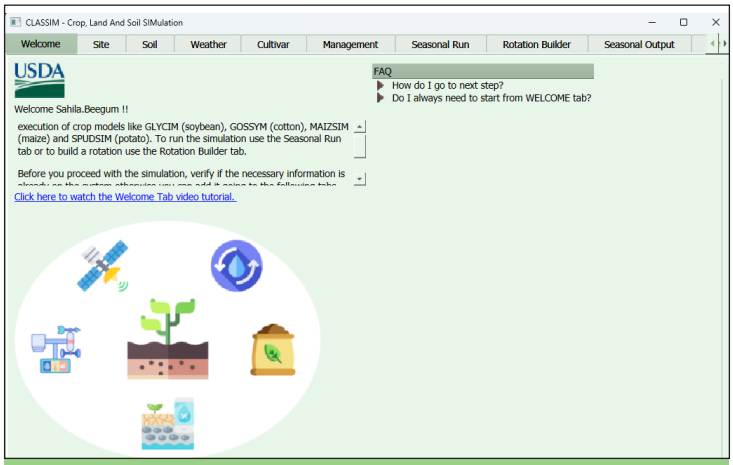
One limitation of the USDA ARS ACSL crop models is the biogeochemistry component. The PhreeqC model is the most widely used standalone model for biogeochemistry, and the group is working on integrating it into the USDA-ACSL crop models. They will collaborate with the developers of PhreeqC on this effort.

The group also developed the world's first cotton fiber quality simulation model, which quantifies cotton quality in addition to yield. This study published in Field Crops Research was featured in ScienceDaily, ScienMag, EurekAlert, MSU Newsroom, and Cotton Grower. Using this model, they created a spatial map for the best planting dates for cotton at the county level in the USA cotton belt, helping farmers and decision-makers select the optimal planting dates for high-quality cotton. The same methodology can be applied to other crop models.

Significant advancements have been made in the interface called CLASSIM, the graphical user interface (GUI) for the crop models. A recent addition is an expert system that provides irrigation recommendations based on soil moisture status.

USDA ARS ACSL, in association with NWC, was invited to provide a one-day, hands-on crop modeling workshop at the "Training Program on Building Climate Resilience Through Crop and Hydrological Modeling" conference. This event was coordinated by the National Agriculture and Forestry Research Institute (NAFRI), the Department of Meteorology and Hydrology (DMH) of Lao PDR, and the Economic Research Institute for ASEAN and East Asia (ERIA). The online and in-person event took place on September 1, 2024, with 47 participants. The workshop focused on providing knowledge and practical skills in using USDA-ARS ACSL-developed crop models and the CLASSIM interface. It highlighted process-based modeling approaches to support climate-resilient planning and decision-making. The crop models the research group are currently improving can be accessed at **go.unl.edu/cropmodels**.

Participants at the Training Program on *Building Climate Resilience Through Crop and Hydrological Modeling* event in Lao PDR.



The USDA-ARS ACSL-developed graphical user interface called CLASSIM (Crop, Land And Soil Simulation).

Updates from the Critical Zone Research Group

By Britt Fossum, PhD Student

The Critical Zone Research (CZR) Group, organized under Principal Investigator Dr. Arindam Malakar (Nebraska Water Center and School of Natural Resources (SNR)), investigates hydrogeochemical dynamics that impact processes within the critical zone (which covers Earth's land surface extending from the top of the vegetation canopy through the soil to subsurface depths at which fresh groundwater freely circulates) that may ultimately impact transport of contaminants like nitrate into groundwater. The critical zone emerges as a focal point for understanding the delicate balance of carbon and nitrogen cycles.

Research in the CZR group includes laboratory-scale column experiments and field-scale experiments, with work from graduate students within SNR and students co-advised in the department of Agronomy and Horticulture.

PhD student Chandan Kumar has been utilizing column experiments studying reactive nitrogen, specifically nitrate transport and biogeochemical transformation in the vadose zone and its subsequent impact on groundwater pollution, particularly in regions where agricultural practices rely heavily on irrigation. This work involves studying how different irrigation methods such as rain fed, pivot, and gravity irrigation influence nitrogen dynamics that could prevent mobility into groundwater and uses a unique design that simulates a soil and groundwater system to monitor impacts of irrigation and fertilizer at various depths in the vadose zone.

MS student Japhet Dushimeyesu performs research focused on other aspects of agroecological systems including sampling of greenhouse gases and has recently completed a three-year crop sampling event at a research site in Sutherland, NE, where the team collaborates with a local farmer. The crop production data will be used to ground next-generation process-based crop simulation models developed by USDA-ARS Advanced Cropping System Laboratory at Beltsville, Maryland.

PhD student Britt Fossum, co-advised by Dr. Michael Kaiser (Agronomy and Horticulture), primarily focuses on soil amendments and how they impact nitrogen and carbon dynamics in agricultural soils. One project established at UNL research farms (ENREEC and SCAL facilities in Mead, NE and Clay Center, NE) has been ongoing since April 2022. It focuses on biochar field aging and impacts on nitrate retention. A second field experiment established at farmland owned by the City of Lincoln aims to clarify how biochar impacts soil properties when applied at 1-acre scales and how combining biochar with biosolid fertilizer may impact nutrient retention and carbon storage. This field experiment has also enabled study of arsenic mobility in soils following biosolid and biochar application through USGS 104b support.

Research under development in this group, involving PhD student Saurabh Sharma and MS student Kaitlyn Richards, focuses on complete nitrogen budgeting in the vadose zone by using samples from agriculturally intensive sites in various natural resources districts (NRDs) in Nebraska that will be used to compare how water management impacts nitrate reactivity under natural environmental conditions. MS student Kalley Collins, co-advised by Dr. Trenton Franz, is studying enhanced rock weathering of olivine to lock carbon dioxide in cropland. She is leading field experiments in Mead, NE.

Column experiments are utilized to study nitrate transport and biogeochemical transformation in the vadose zone.

USGS-supported undergraduate student Kira Hall and PhD Student Chandan Kumar collected soil pore water samples to study reactive nitrogen transformation in the vadose zone.

MS Student Japhet Dushimeyesu is studying greenhouse gas production in the vadose zone.

Bioplastics with Regenerative Agricultural Properties: BioWRAP

By Karina Schoengold, NWC Associate Director

Researchers at the University of Nebraska, including Nebraska Water Center Director (Dr. Ray) and Associate Director (Dr. Schoengold) are working with researchers at UNL, Kansas State University, and South Dakota School of Mines on a National Science Foundation funded project called BioWRAP. The acronym BioWRAP stands for *Bioplastics with Regenerative Agricultural Properties*.

The goal of the BioWRAP project, which started in March 2022, is to create a new product that is effective for weed suppression in agricultural production. BioWRAP are biological products produced from agricultural byproducts. The overarching goal of the project is to reduce the use of plastics, herbicides, and associated environmental impacts in agricultural production. The long-term goal is to create locally sourced, customizable, spray-on biopolymer-based films to serve as soil cover that can be synchronized to crop growth cycles under differing climatic conditions and applied using precision agricultural equipment.

To achieve this, research activities in the project include developing and testing spray-on, biodegradable polymers that could be applied on row crop fields to reduce plastic and herbicide use. The three focus areas of the overall project are 1) create a set of bio-based polymers that can be used in agricultural production; 2) measure the agricultural effectiveness and associated environmental impacts of the technology; and 3) estimate the potential social and economic impacts on communities and the agricultural economy of the proposed technology.

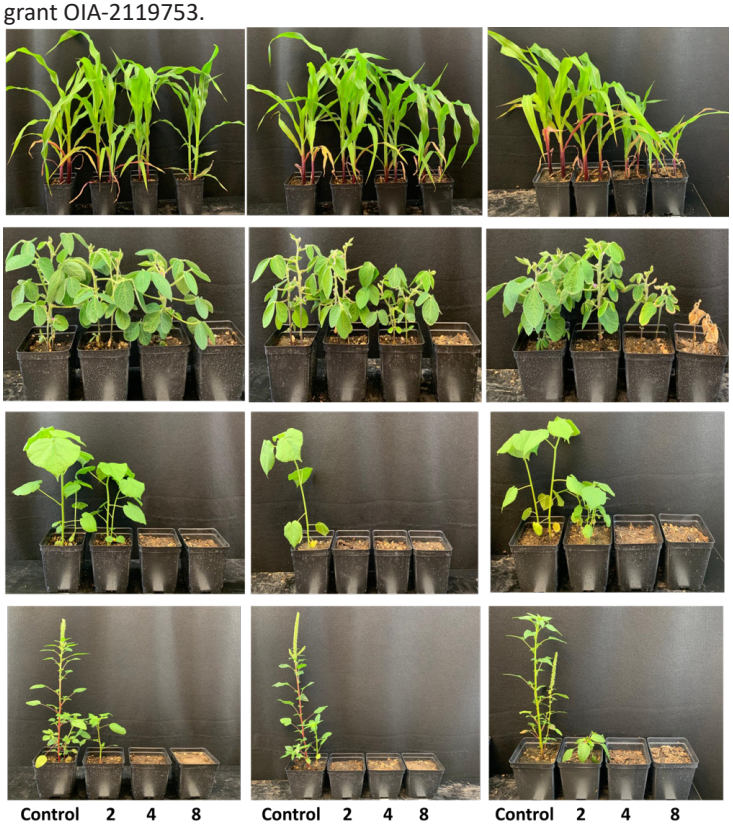
Recent activities that the UNL team of BioWRAP researchers have completed include developing a protein-based biopolymer and testing the performance of the product in the greenhouse. The current process uses hydrolysis of chicken feather waste to create keratin for the sprayable bioplastic. The research team has tested different BioWRAP application rates on soybean plants with varying management practices (e.g., additional herbicides, cover crops, etc.). UNL researchers have completed field trials at the UNL Havelock Research Farm fields in the 2023 and 2024 planting seasons and at the Eastern Nebraska Research, Extension, and Education Center (ENREEC) for the 2024 planting season.

Lab testing of alternative BioWRAP formmulations.

Results from the 2024 field trials suggest that applying BioWRAP in a banded application pattern (between crop rows) is as effective at weed control as BioWRAP application across the entire area, while the banded application increases crop yield relative to broad application across the entire area.

One aspect of the project is to evaluate the potential commercial market for a BioWRAP product. Using a survey of current home gardeners, UNL researchers recently evaluated the willingness to pay (WTP) of home gardeners for a BioWRAP product that would replace current weed suppression practices. Results show that WTP is highest to replace sprays and granular products ($75-$143), followed by physical barriers with a cost ($59-$120), manual labor ($54-$84), and no-cost physical barriers ($35-$63). Dollar values indicate a total WTP for a single growing season/year.

The BioWRAP project is supported by National Science Foundation grant OIA-2119753.



Greenhouse trials of protein-based BioWRAP product. Application rates include No BioWRAP product and 2, 4, and 8 liters per square meter. Plants used for testing include corn, soybean, velvetleaf, and Palmer amaranth.

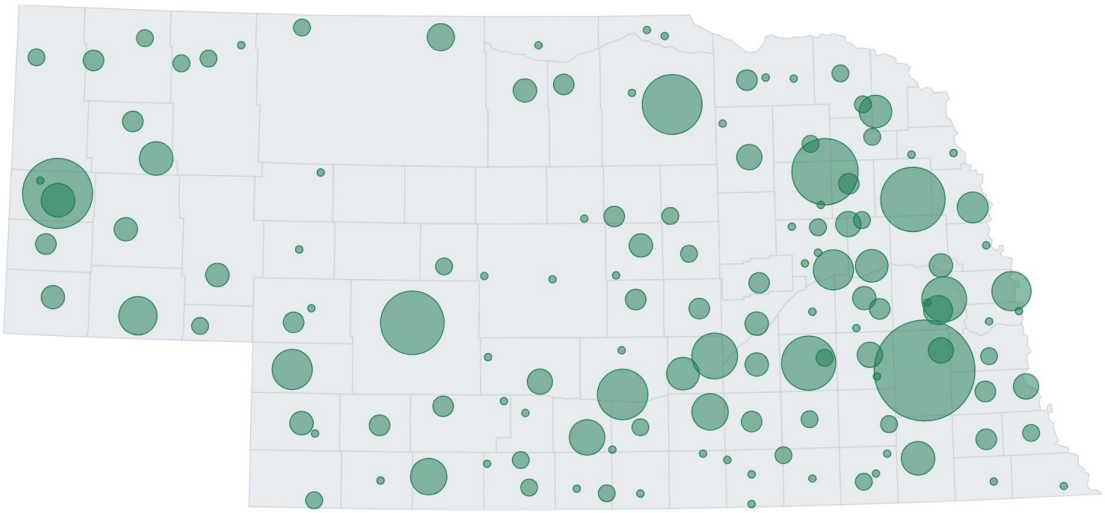
Extension Water and Cropping Systems Impact 2024

By Crystal Powers, Water Extension Educator

The University of Nebraska's Water and Cropping Systems Extension team is here for you, wherever you live in the state. The Water and Cropping Extension team is located around the state to provide locally relevant, unbiased, research-based information for a diversified agricultural audience. Find your local connection at **epd.unl.edu.**

The map below shows the impacts of the Water and Cropping Systems Extension team across the state. Larger dots represent a higher number of events held in that community. In-person events are held around the state throughout the year and digital materials are provided through UNL CropWatch at **cropwatch.unl.edu** and UNL Water at **water.unl.edu**.

In 2024, the University of Nebraska's Water and Cropping Systems Extension team impacted 26,209 event participants in 885 sessions and held 21,538 one-on-one conversations.

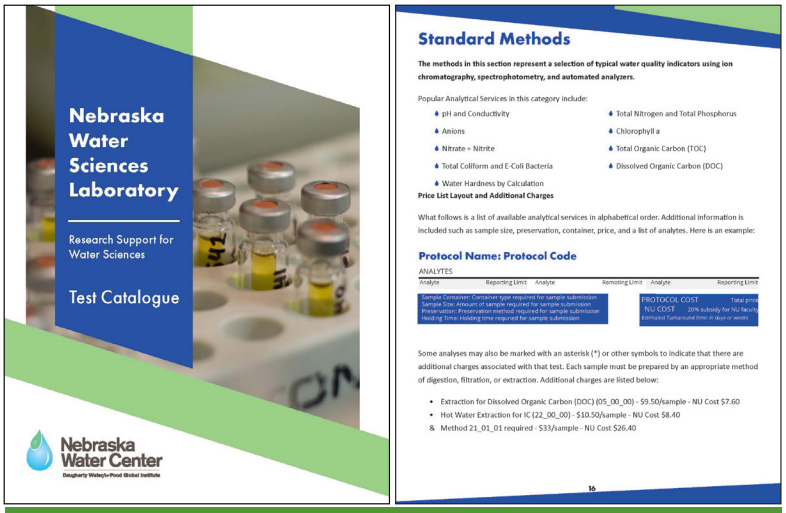


Water Sciences Laboratory publishes new price list

By Ann Briggs, Public Relations and Engagement Coordinator

The Water Sciences Laboratory has updated and reorganized their price list to be easier to navigate and more user friendly. This update includes all sample workflow and requirements and the available test methods in a single file. Available tests are organized into four categories: standard methods, trace elements, environmental, and stable and radiogenic isotopes. The online PDF is searchable and includes embedded navigation to make it easy for lab users to find exactly what they're looking for. Additional details about standard quality assurance practices, sample sizes, preservation, turnaround time, training requirements and much more are spelled out in great detail to help clients understand and better use the laboratory services.

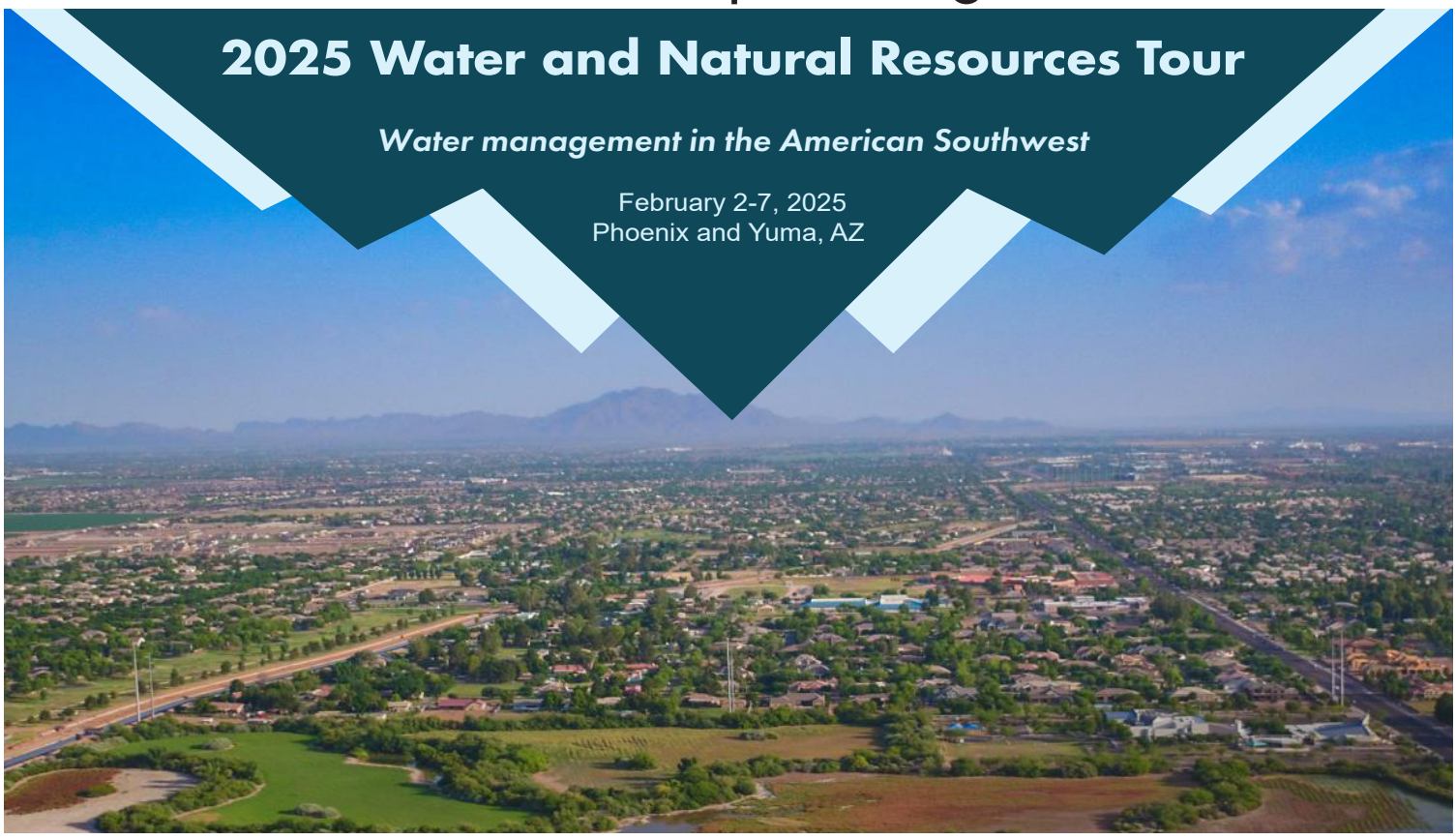
The new Water Sciences Laboratory price list can be found at **watersciences.unl.edu/price-lists**. Printed copies are available upon request.



Sample pages from the updated Water Sciences Laboratory Price List.

University of Nebraska System
Nebraska Water Center
Daugherty Water for Food Global Institute at the University of Nebraska
P.O. Box 886204 | 2021 Transformation Drive, Suite 3220
Lincoln, NE 68588-6204

Join us at our upcoming event



For more details and to register to attend, visit **go.unl.edu/watertour**