Water*for*Food
DAUGHERTY GLOBAL INSTITUTE
at the University of Nebraska

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Front: The Dismal River meanders through the Nebraska Sandhills at Nebraska National Forest in late summer.
Credit: marekuliasz | Shutterstock

2020

Annual Report

FY2020 (JULY 1, 2019 TO JUNE 30, 2020)

+

10-Year Progress Report

Peppers from a SEEDS student's trip to Rwanda with DWFI. *Photo: David Munyaneza*

NDMC	National Drought Mitigation Center at the University of Nebraska–Lincoln
Nebraska EPSCoR	Nebraska's Established Program to Stimulate Competitive Research
NET	Nebraska Environmental Trust
NEWBA	Nebraska Water Balance Alliance
NGO	Non-governmental Organization
NIC	Nebraska Innovation Campus
NRDs	Natural Resources Districts
NRT	NSF Research Traineeship
NSF	National Science Foundation
NU	University of Nebraska
NWC	Nebraska Water Center
NWPR	Nebraska Water Productivity Report
OWCAP	Ogallala Water Coordinated Agriculture Project
RBDF	Robert B. Daugherty Foundation
SEEDS	Service, Engagement, Entrepreneurship, Development, Sustainability
SETMI	Spatial Evapotranspiration Modeling Interface
SWM	Smart Water Meters, Inc.
TCC	The Climate Corporation
UAV	Unmanned Aerial Vehicle
UNL	University of Nebraska–Lincoln
UNMC	University of Nebraska Medical Center
U.S.	United States
USAID	U.S. Agency for International Development
USDA	U.S. Department of Agriculture
USDA-ARS	U.S. Department of Agriculture - Agricultural Research Service
USDA-NIFA	U.S. Department of Agriculture - National Institute of Food and Agriculture
USDA-OCE	U.S. Department of Agriculture - Office of Community Engagement
USIEF	United States-India Educational Foundation
WARI	Water Advanced Research and Innovation
WB	World Bank
WFGC	Water for Food Global Conference
WFIF	Water for Food International Forum
WHO	World Health Organization
WP	Water Productivity
WSL	Water Sciences Lab

2020 Letter from the Executive Director

Peter G. McCornick

For 10 years, the Daugherty Water for Food Global Institute at the University of Nebraska has worked toward one audacious goal: a water and food secure world. While we have yet to achieve the vision shared by Bob Daugherty and others who are passionate about solving this complex challenge, we have made important and measurable progress.

Our board leaders help guide our success, and we were fortunate to add the University of Nebraska's new President, Ted Carter, as chair this year. We also added a new director, Felicia Marcus, former chair of the California State Water Resources Control Board and current member of The Water Policy Group.

Water and food security have become an even more important global priority due to the COVID-19 pandemic – a health crisis that has affected many aspects of our daily lives. This includes an unexpected and extreme shock on our agriculture, food and water systems. Farmers, ranchers and dairy producers, many still recovering from massive floods, droughts or severe weather, are now dealing with further market turmoil. As with other global crises, the most adversely affected are the poorest and most vulnerable segments of the population, including refugees, the displaced, and those in areas of conflict, where access to food and water is a constant struggle. Like many of our partners, we have worked remotely from spring through summer, collaborating, promoting research and continuing outreach to advance our mission.

A generous and strategically important gift from Dr. Anne Hubbard and the Claire M. Hubbard Foundation established a new program to address some of the state's most pressing public health issues associated with climate, water and agriculture. The new Water, Climate and Health Program is based in the University of Nebraska Medical Center's College of Public Health and is closely aligned with the Institute of Agriculture and Natural Resources and the Daugherty Water for Food Global Institute. As part of this program, we were very pleased this year to welcome Jesse Bell, PhD, Claire M. Hubbard professor of health and the environment, to the DWFI leadership team.

Like other organizations planning international events, we had to cancel the 2020 Water for Food Global Conference due to travel restrictions. The success of our global conferences the past decade has helped establish DWFI as a respected convener, enabling us to offer a webinar series this fall with partners, including the World Wildlife Fund, the Water Policy Group and the Irrigation Innovation Consortium. We are also attracting top talent for keynote speaking, such as Louise Mabulo, a rising leader named Young Champion of the Earth by the United Nations Environment Program and a Forbes 30 Under 30 - Asia 2020 honoree.

Along with the World Bank, the International Water Management Institute, the Global Water Partnership and others, we developed and hosted a two-part webinar series this summer on "Accelerating Inclusive Farmer-led Irrigation." Both webinars had over 400 active attendees from more than 100 countries and hundreds more have viewed the webinars on DWFI's YouTube Channel, reaching stakeholders that our in-person conference could not. Closer to home, the Nebraska Water Center, along with the North Platte Natural Resources District, hosted the 2020 Nebraska Water Conference online in August.

We have continued progress on a number of international projects, including research on strategies for sustainable irrigated agriculture for the government of Kazakhstan; development of a drought and soil moisture monitoring tool in the MENA region; advancement of eddy covariance crop evapotranspiration tools; and, review and analyses of irrigation business models for smallholder farmers in Rwanda, which we are aiming to expand to other countries with a recent $1 million grant from a new partner, the International Fund for Agricultural Development.

Our work in Nebraska has also expanded and matured. A prime example is the Ogallala Water Coordinated Agriculture Project, led by a multi-state team including DWFI's Nebraska Water Center. This USDA NIFA-funded effort has brought together producers, scientists, groundwater managers, students, and public and private organizations to support research and adoption of practical approaches to sustain the Ogallala Aquifer.

Prior to the onset of the COVID-19 crisis, we hosted numerous events here in Nebraska and around the world. At home, we led and participated in workshops and meetings on a variety of topics, including degradation of water quality, focusing on nitrate level monitoring and mitigation. Especially notable was the well attended 2019 Nebraska Water Conference, held in Norfolk, Nebraska. It attracted producers, NRDs, private enterprises, public agencies, universities and colleges, politicians and students. We also organized a Nebraska farm visit for FCC Chairman Ajit Pai.

Further afield, we launched the Nebraska Water Productivity Report at the World Food Prize in Des Moines; presented a keynote address at the World Irrigation Forum in Bali; and, participated in World Water Week in Stockholm.

Together with university leaders, we shared testimony with the Nebraska Legislature in support of a budget appropriation to advance water research in the state. Nebraska's water resources support our $25 billion agricultural economy, sustain wildlife and the environment, and, of course, provide what we need for healthy daily living. Improving how we manage water can make a tremendous difference in Nebraska's economy and the quality of life for our citizens – a fact recognized when Governor Ricketts signed Nebraska's 2021 budget bill in August, which included $500,000 designated annually to the institute to further water research in the state. While it is not surprising given the recognition of the importance of water resources, it is humbling to see this level of commitment. The institute will make the most of this investment to develop innovative water security solutions.

Educating and cultivating future leaders and researchers in water management and agriculture are essential for us to deliver on our mission. To bring many different perspectives to these complex challenges, DWFI fosters innovative research across many different disciplines within the university system through our student research support program. Many of our students have graduated to pursue doctoral or post-doctoral programs, launch entrepreneurial start-ups, or have joined prestigious organizations and agencies that are shaping the future of water management. You will see an exciting variety of student research projects in this report, which students shared through videos and papers since we were unable to host our annual faculty and student forum in the spring.

If you've already heard about many of these accomplishments, it's due to our communications efforts, which are amplified by the retweets, shares and engaging comments of our wide stakeholder network. Through videos, presentations, postings, news releases, website updates, podcasts, photos, the monthly e-newsletter, and this annual report, we strive to share the exceptional work of our staff, faculty, students and colleagues.

I hope you will enjoy discovering more about our progress and review the historic impacts we have achieved in our first decade. As COVID-19 has made clear, we have much more work to do. It will take all of us, working together, to achieve a world with ample water for all of our needs and enough nutritious food to ensure everyone's good health and quality of life.

Peter G. McCornick, PhD, PE, DWRE
Executive Director
Robert B. Daugherty Water for Food Global Institute at the University of Nebraska

Soybean harvest by the Spohn Farms combine crew near Friend, Neb., USA.
Photo: Craig Chandler | University Communications

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DWFI collaborated with the Water Technology Center (WTC) team at the Indian Agricultural Research Institute (IARI) to identify a critical canopy temperature threshold for wheat crop. Photo: DWFI

2020 Global and National Research

The Daugherty Water for Food Global Institute conducts and supports research to develop innovative solutions for achieving water and food security at home in Nebraska and around the world. Through the work of our staff, faculty, students and many partners, we are finding ways to help farmers achieve better yields, use water more effectively and adapt to and mitigate the effects of climate change.

DWFI staff talk with smallholder farmers in Rwanda. *Photo: DWFI*

DWFI strengthening its engagement in the entrepreneurial ecosystem

The institute is working on a variety of projects to support the entrepreneurial ecosystem for agricultural and water technology and innovation — both in the U.S. and around the world.

Irrigation development can bring greater crop productivity, incomes, nutrition, food security and employment opportunities for smallholder farmers. Cost-effective scaling of smallholder irrigation could unlock significant potential for increased crop production and result in a more stable income for the bulk of the population. The key is to find a model that works and then scale that system with equitable access and sustainable practices.

DWFI initiated research to study the viability of various irrigation business models in Rwanda as a means of improving smallholder productivity and livelihoods. The DWFI policy team met with participants in irrigated agriculture, including governmental and non-governmental organizations' staff, entrepreneurs and smallholder farmers to gain a better understanding of what is happening on the ground in Rwanda. The team explored the models that are currently used and the trials and successes of each.

An important goal of the research is to use entrepreneurial tools and methods to understand the financial sustainability and scaling potential of the diverse range of existing irrigation provision business models. The team will soon release an in-depth report of their findings.

DWFI recently secured a $1million grant from the International Fund for Agricultural Development (IFAD) to expand and promote the sustainability and resilience of smallholder irrigation in sub-Saharan Africa. The three-year project is designed to identify and promote opportunities for inclusive and sustainable provision of irrigation water services to smallholders. The project's direct target group will consist of entrepreneurs, young professionals, and other young people engaged or interested in agricultural development in the selected countries, and smallholder farmer households.

Planned activities spanning six countries in East Africa and West Africa will provide research, needs-based technical guidance and other capacity building to support entrepreneurship centered around irrigated agriculture. These activities support DWFI's goals to collaborate with multiple agricultural enterprises to understand, test and validate business models for new agricultural technologies and services and to strengthen the overall entrepreneurial ecosystem. The project will leverage existing connections and engagements of DWFI and the University of Nebraska–Lincoln (UNL) in sub-Saharan Africa.

Flux towers enhance evapotranspirationmeasurements

Knowing when, where and how much water to apply to crops is a ubiquitous challenge for farmers. With funding from the Foundation for Food and Agriculture Research through the Irrigation Innovation Consortium (IIC), of which DWFI is a founding member, the institute is researching how to use the Parallel 41 Flux Network to monitor and measure crop water needs. The network is a series of eddy covariance flux towers across the central United States.

The Parallel 41 Flux Network provides the most accurate method of measuring ET (evapotranspiration: total plant transpiration and soil evaporation into the air), a key measurement for determining a crop's unique daily water needs. Accurate and timely ET data is necessary for assessing water budgets, water productivity, plant stress and drought – ultimately helping growers precisely apply the amount of water that crops need, when they need it, to achieve the best possible yields.

The network towers are situated to represent different climate conditions, precipitation amounts and crop types. In the past year, with support from the IIC and LI-COR Biosciences, DWFI upgraded six of the existing towers using new hardware and software that provides data in real time, greatly enhancing the network utility.

Daily ET measurements from these flux towers are freely available to farmers, NRD managers, scientists and others through the Parallel 41 website:
parallel41.nebraska.edu

The flux tower measurements also are used to ground truth GloDET datasets. GloDET is a global satellite-based daily ET monitoring system launched by DWFI and partners in USDA-ARS, NASA and the University of Maryland in 2017. Last year, DWFI updated GloDET, adding 2018 and 2019 to the database in the MENA region, and is continuing to work toward the goal of real-time ET mapping. The GloDET portal provides free access to ET data:
glodet.nebraska.edu

The GloDET project delivers new insights, management plans and drought resilience strategies at national and local levels to reduce drought impacts on food supplies and on the quantity and safety of water supplies in vulnerable communities.

GloDET datasets presently are being tested against energy balance flux data collected by the Parallel 41 eddy covariance towers in the central plains of the U.S., as well as in Brazil, in a project funded by Brazilian Federal agencies ANA and CAPES. This project is a

partnership between DWFI and University of Sao Paulo, Federal University of Rio Grande do Sul, Federal University of Santa Maria, and the Brazilian Space Agency – INPE. The goal is to compare ET measured with eddy covariance flux towers in several natural and agricultural ecosystems in Brazil.

In the future, the daily ET product can be used to extend the estimation of the Evaporative Stress Index used in drought detection and early warning.

Eddy covariance flux towers measure the ecosystem's "breath," – the CO2 and other gases that are exchanged between soil, vegetation and air. Photo: LI-COR Biosciences

DWFI Director of Research Christopher Neale signs a memorandum of understanding with Minister Mirzagaliyev, minister of ecology, geology and natural resources of the Republic of Kazakhstan. Photo: Republic of Kazakhstan

Kazakh agriculture and water leaders invite DWFI's expertise

Last fall, a group of DWFI leaders and faculty presented a seminar at the Kazakh National Agrarian University in Kazakhstan, along with representatives from Valmont, to share information on advanced groundwater management and irrigation methods to improve crop and water productivity.

Leaders from Nebraska presented a seminar focused on the use of surface water and groundwater resources for irrigation in southern Kazakhstan and on attracting investors. The meeting participants examined problems related to water management, as well as the use of water resources and irrigation equipment. Participants expressed their intention to create an industrial center for the production of irrigation equipment and to strengthen mutually beneficial partnerships.

DWFI and the University of Nebraska–Lincoln later signed a memorandum of understanding with agriculture and water leaders from Kazakhstan. In an exploratory report, DWFI leaders provided Kazakhstan stakeholders with technical analysis of the Turkestan Canal and basin, examining the state of the irrigation canal and distribution system, groundwater availability and other observations.

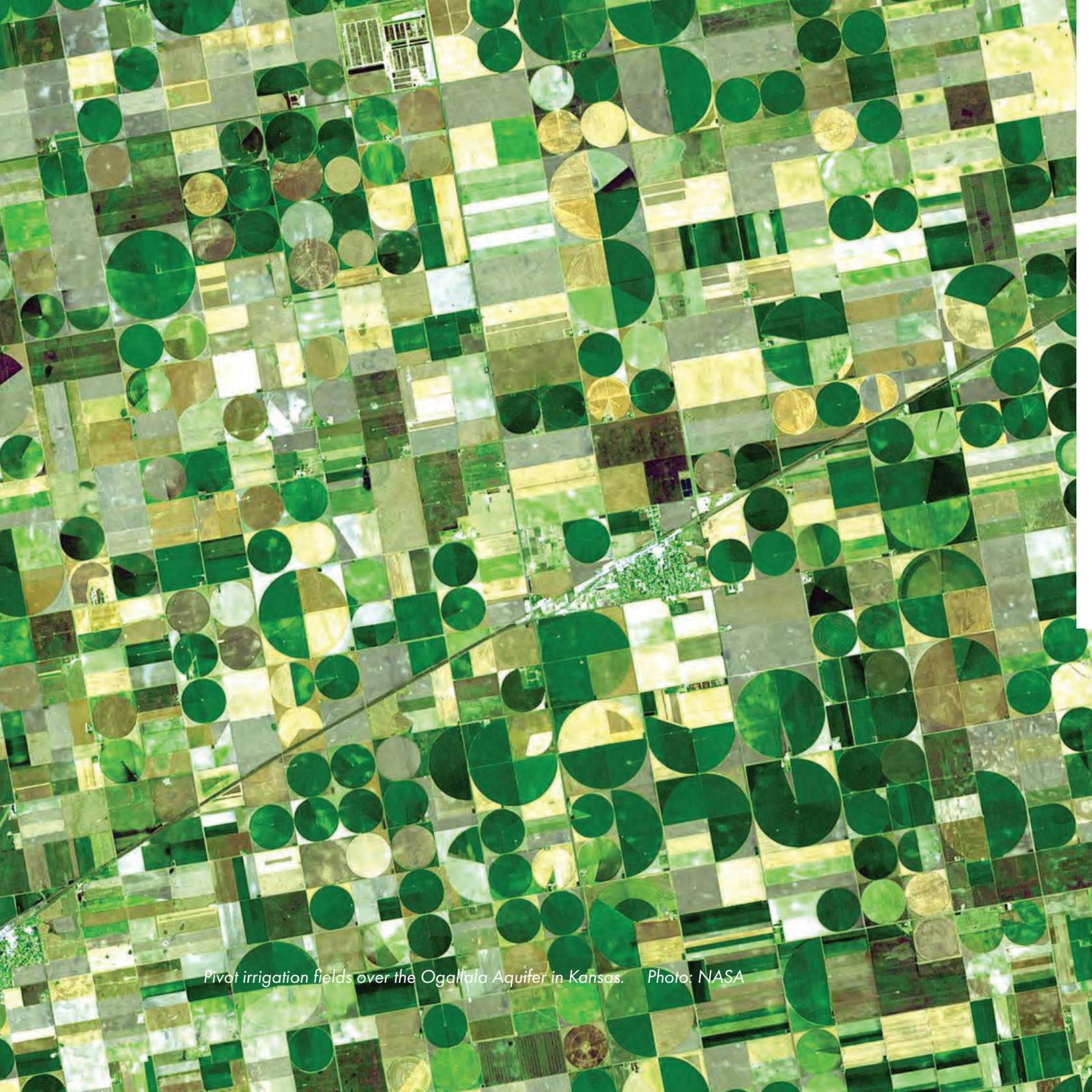
From soil to satellites: soil moisture monitoring improves VRI prescriptions

Variable rate irrigation (VRI) provides the most specific data available to help farmers determine the amount and timing of water application for crops. VRI methods may improve irrigation water productivity, reduce pumping, save energy and reduce deep percolation of water below the root zone which reduces nitrate leaching.

Producers use the data collected by soil-moisture monitoring sensors to base irrigation schedules on actual field conditions. This creates more accurate and precise VRI prescriptions, which can be updated weekly throughout a growing season.

The Improving VRI project is in its third year. DWFI's director of research, along with several Faculty Fellows and graduate students from UNL Biological Systems Engineering, are working with satellite and unmanned aerial system remote sensing informed models to develop simple, automated, clearly beneficial systems, which have the greatest likelihood of adoption by farmers.

Illustration of Landsat satellite *Credit: NASA's Goddard Space Flight Center*



Pivot irrigation fields over the Ogallala Aquifer in Kansas. Photo: NASA

Protecting and preserving the Ogallala Aquifer

DWFI's NWC team continued its work as a leader of the multistate Ogallala Water Coordinated Agriculture Project (OWCAP). Since its inception in 2016, this effort, funded by the USDA NIFA, has brought together producers, scientists, groundwater managers, students and public and private organizations into a coherent project that supports research and encourages greater visibility and adoption of practical approaches to help extend the productive life of the Ogallala aquifer. For example, the Testing Ag Performance Solutions (TAPS) program that spawned from conversations between a key producer and junior and senior faculty at UNL's West Central Research & Extension Center is now completing year four. Recently, a new TAPS spinoff program has started in Nebraska and Oklahoma (with Oklahoma State University as partner).

View NWC's special edition Water Current (Spring 2020) featuring the outputs, outcomes and impacts of the OWCAP project to date: ***go.unl.edu/current2020spring.***

DWFI Director of Research Christopher Neale attends the 71st meeting of the Board of Governors of the World Water Council in Liège, Belgium, on Feb. 5, 2020. Photo: World Water Council

DWFI at the global water table

DWFI's executive director serves on the World Water Council (WWC) Board of Governors with the director of research serving as assistant governor. As a member of this group, DWFI is engaged in planning the 9th World Water Forum (WWF) in Dakar, Senegal, which at the time of writing, was scheduled for March 22–27, 2021. Planning for the forum continues, with consideration for the challenges presented by COVID-19. The most recent WWC board meeting was virtual, and the second stakeholders consultation meeting, which had been scheduled for July, was replaced with a virtual collaborative platform for the main working groups. In addition, DWFI's executive director was also recently re-elected to the Global Framework on Water Scarcity in Agriculture (WASAG), an international partnership focused on addressing water and food security.

Reclaimed water can be a safe alternative in food processing

In water-scarce regions, people optimize their use of water to conserve the resource. Research shows that water reuse is the best approach for resiliency and sustainability. However, many consumers, food processors and regulators fear contamination of reused water in the food industry.

A new study by DWFI, led by Research Professor Yulie Meneses, addresses issues and concerns related to wastewater reuse in the food industry. The researcher team found that reclaimed water can be safely used as an alternative to potable water in food processing systems. Read the study report online: ***go.unl.edu/reclaimwaterpaper*** or watch a video summary from the researcher: ***go.unl.edu/reclaimwater.***

Technology now available allows the industry to clean the water used in food processing well enough to achieve the desired level of quality for reuse — including use for cleaning food processing equipment. The cost of treating wastewater for release into the ecosystem can be significant for food processors, and communities often see wastewater release as undesirable. Reusing water optimizes food processing operations while avoiding the need to release wastewater into the environment.

Wastewater reuse testing in Meneses's lab at Nebraska Innovation Campus. Photo: DWFI

2020 Nebraska Research

DWFI amplifies leadership of the Nebraska Water Center (NWC) and Water Sciences Lab (WSL) to benefit Nebraskans. From water quality research to developing new farming software, projects of the institute and its partners throughout the state are dedicated to maintaining Nebraska's position as a national and global leader in effective water management for sustainable agricultural production.

A corn silk in a field near Albion, Nebraska, USA. Photo: DWFI

Sandhills cattle ranch. *Photo: Brett Hampton Photography*

Research on water footprint of cattle production featured in 2020 Nebraska Beef Cattle Report

DWFI first introduced the Nebraska Water Productivity Report (NWPR) at the 2019 Water for Food Global Conference in April, then reviewed, finalized and officially launched it at the World Food Prize conference in Des Moines, Iowa, in October 2019. The report underscores Nebraska's leadership in crop and water management.

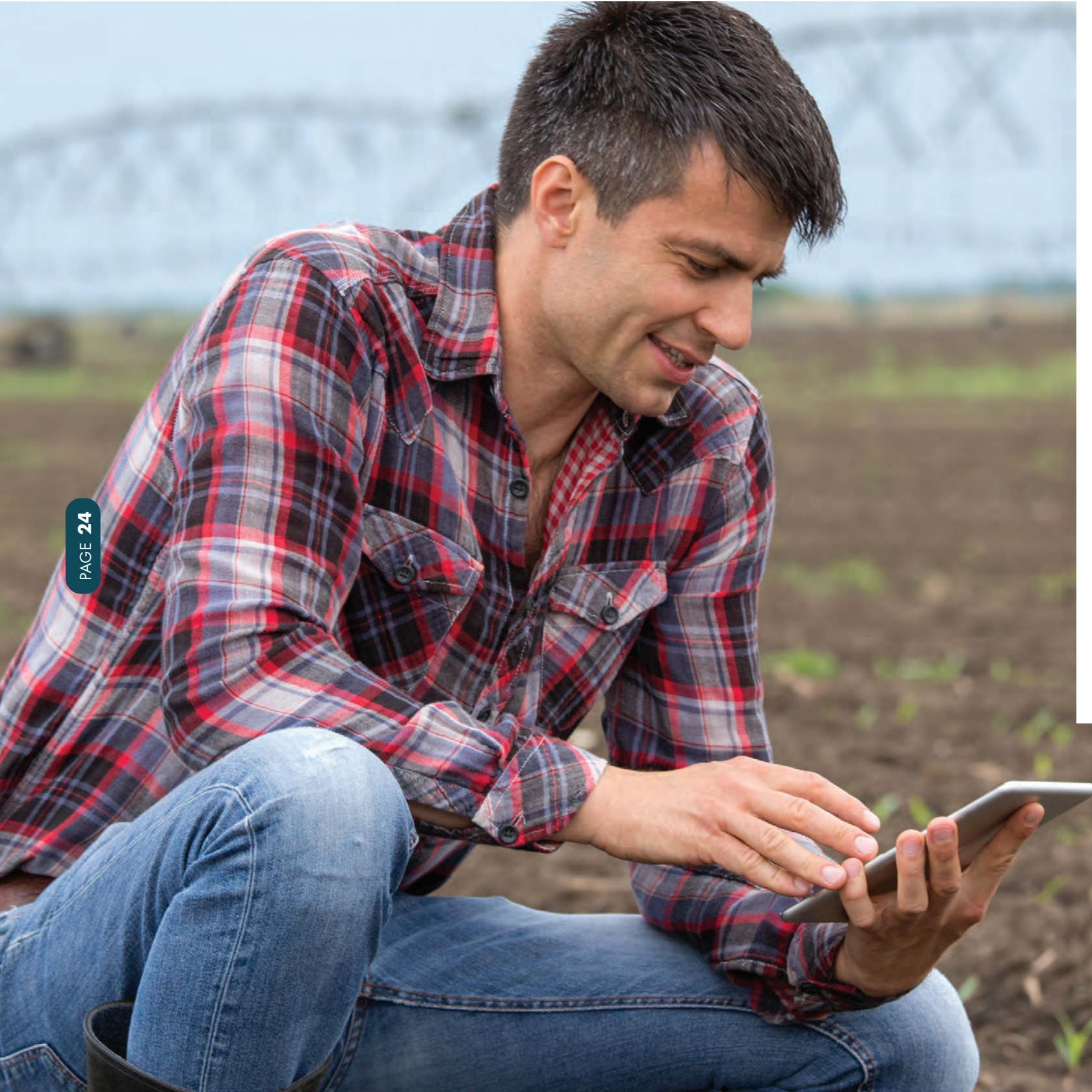
Over the last 25 years, the state's corn and soybean yields have grown considerably, with less water use. This significant increase in grain yields, combined with the adoption of improved farm-level management, advanced irrigation systems and regulatory limits on irrigation pumping, has helped improve the water productivity of crop and livestock production in the state. From 1990 to 2014, the water productivity of soybeans and corn increased by 79 percent and 71 percent, respectively.

As an outcome of the NWPR, the Food and Agricultural Organization invited DWFI to contribute to this year's influential State of Food and Agriculture (SOFA) report. The contributed articles were "Closing the water productivity gaps of crop and livestock products: a global analysis," with DWFI research associate Mesfin Mekonnen as the lead author, and "Water use in the food industry," authored by Yulie Meneses, DWFI's water for food processing specialist. Information from these articles was used in various chapters of the forthcoming SOFA report.

The NWPR also was featured in the University of Nebraska–Lincoln Animal Science Department's 2020 Nebraska Beef Cattle Report — an annual summary of research conducted by scientists and graduate students for use by livestock producers, extension educators and agribusiness.

View the Nebraska Beef Cattle Report: ***go.unl.edu/beefcattlereport.***

View the NWPR at: ***go.unl.edu/waterproductivity.***

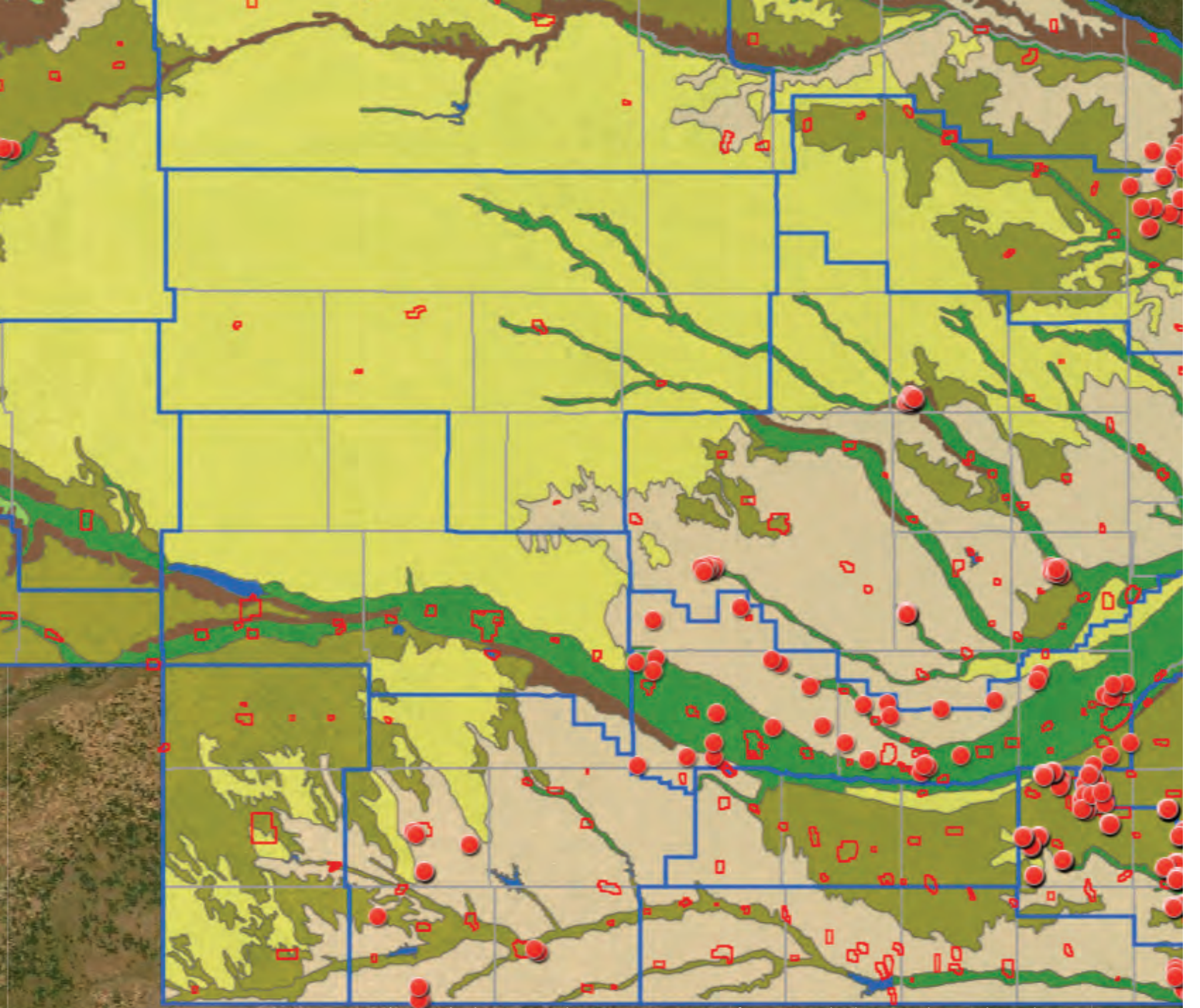


DWFI uses Wells Fargo Innovation Incubator grant to support cleantech start-ups impacted by COVID-19

In the wake of the COVID-19 pandemic, the institute has engaged in collaborative research to help agricultural producers and entrepreneurs manage the enormous challenges the pandemic and the resulting public quarantines are having on the food-producing sector.

One such collaboration is with Invest Nebraska, an organization that helps grow Nebraska's economy by assisting entrepreneurs and investing capital in companies with growth potential. With the support of a grant from the Wells Fargo-funded Innovation Incubator based at the National Renewable Energy Laboratory, DWFI staff are working with The Combine, an initiative of Invest Nebraska that supports high-growth entrepreneurs in food and agriculture. The program activities consist of a variety of needs-based technical support, including workshops, individual mentoring, educational curricula development and rent support for start-ups housed in the Combine's space at the Nebraska Innovation Campus.

A grower uses tablet technology to manage an irrigation system for his cornfield. Photo: Shutterstock



An interactive map depicts the locations where measurements of nitrate and other agrichemicals, such as pesticides and heavy metals, have been recorded in the vadose zone in Nebraska.
Photo: nebraskavadosezone.unl.edu

Nebraska Vadose Zone Program helps water managers predict future water quality challenges

With funding from the Nebraska Environmental Trust (NET), Nebraska Department of Environment and Energy (NDEE), and several Natural Resources Districts (NRDs), NWC launched the Nebraska Vadose Zone Program in 2015. The program, nearing completion, is a unique agrichemical data repository to help manage and improve the state's groundwater and drinking water quality.

The program's centerpiece is an interactive GIS map merging historical and current deep soil core data. This data produces the most comprehensive picture yet of how agrichemicals move through the vadose zone – the soil layer between the land surface and the groundwater table. This soil layer acts as the Earth's skin to regulate groundwater recharge and chemical movement.

In Nebraska, four of every five residents get their drinking water from groundwater. Unfortunately, nitrate concentrations in groundwater in some parts of the state are rising. Naturally occurring elements, such as uranium, further complicate groundwater quality. If these compounds are found in public water systems above regulated limits, utilities must treat the water or find an alternate supply – both of which can be cost-prohibitive for small communities. NRD managers, city planners, treatment plant operators, regulators, researchers and others have a stake in monitoring the vadose zone to anticipate if and when these substances will reach the groundwater supply, and in what quantities, a geochemical process that can take decades.

The Nebraska Vadose website at ***nebraskavadose.unl.edu*** provides data directly to NRD managers and utilities managers who are determining land use and cropping management policies designed to reduce nitrate and agrichemical loading to the water table. The improved online availability of deep vadose zone monitoring data allows questions to be asked and answered quickly, without users having to sift through hardcopy reports and archived data.

View a new video summarizing the vadose zone research: ***go.unl.edu/vadosezone.***

Testing farms for nitrogen leaching

The Bazile Groundwater Management Area (BGMA) is a 756-square-mile area with high groundwater nitrate levels that spans three northeast Nebraska counties. A nationally-recognized BGMA plan was adopted by the state and the four NRDs in this area. They asked the NWC and UNL Extension to partner with them to address these high nitrate levels on multiple fronts.

First, through a Nebraska Environmental Trust (NET) grant, researchers are helping establish local demonstration farms to model different management practices that may help reduce nitrogen leaching. On the demonstration farms, advanced technologies, such as VRI, nitrogen sensors and soil moisture probes, will augment evaluation of nitrate leaching.

Complementing these efforts is a new citizen science project from NET entitled "Project Citizen Science: A Valuable Approach for Monitoring Groundwater Quality in the Bazile Groundwater Management Area." The initiative engages students from five area high schools and will help each school sample 30 rural wells through science classes, clubs and Future Farmers of America (FFA) chapters.

Nebraska Water Center, UNL Extension convene nitrate workshops

In January 2020, leaders from across Nebraska convened to look at new ways to approach an old water challenge. The nitrate strategy meeting – facilitated by DWFI, NWC, UNL's School of Natural Resources, and Nebraska Extension – sparked the development of several short-term priorities to improve nitrate and water-quality issues.

At the meeting, participants zeroed-in on four major categories: building trust and promoting pride in Nebraska's water resources; education; policy; and development of alternative markets for low-nitrogen cropping systems.

The 40-plus meeting participants identified working groups to achieve the objectives and committed to the five-year goal of improving nitrate/water-quality issues in Nebraska. Participants broadly committed staff time, money and other resources to the project.

Nebraska water leaders convene to discuss strategies to ensure clean drinking water. Photo: DWFI

Federal Communications Commission (FCC) Chairman Ajit Pai meets Nebraska farmers on a DFWI-coordinated visit. Photo: DWFI

Connecting stakeholders

DWFI not only shares Nebraska knowledge globally, but also brings key stakeholders and partners from across the U.S. and foreign countries to Nebraska. Last fall, DWFI coordinated a farm visit for Federal Communications Commission Chairman Ajit Pai as part of a visit to UNL. Chairman Pai toured a local farm and visited with Nebraska growers to discuss precision agriculture and ways to improve Internet connectivity to farms and rural communities.

The institute also hosted The State of Bahia Secretariat of Environment and researchers from the Federal University of Vicosa, Minas Gerais, to discuss smallholder irrigation projects, including developing a new training center for agricultural students and farmers in Brazil. This multi-partner collaboration could result in a significant impact if the introduction of a new form of groundwater governance and development of additional irrigated areas results in economic investment in the region.

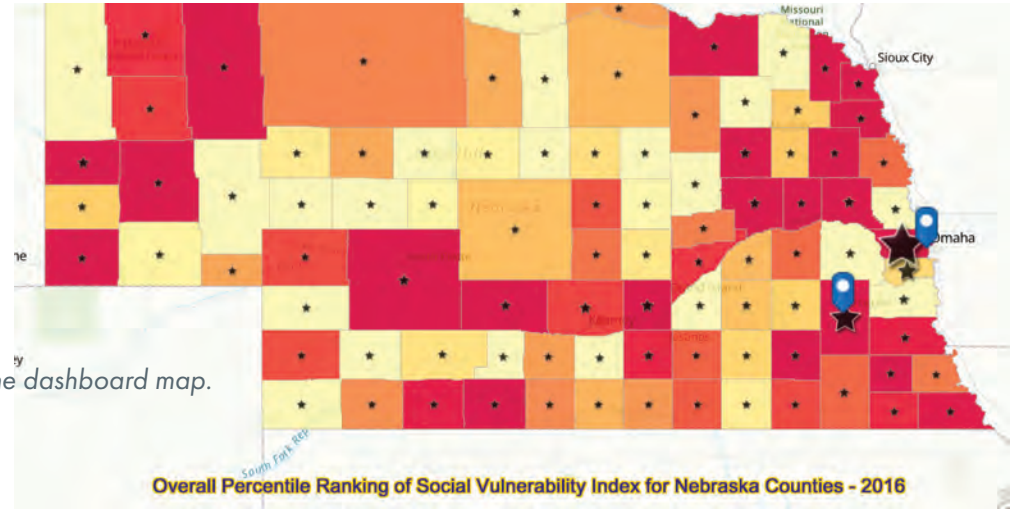
Dashboard maps COVID-19 data with resource capacity, social vulnerability and population density

A Nebraska COVID-19 dashboard map, developed by DWFI Faculty Fellow Jesse Bell and colleagues, shows confirmed cases and deaths from the virus, along with vulnerable population data and health care resources. The map provides valuable insight to aid local decision makers.

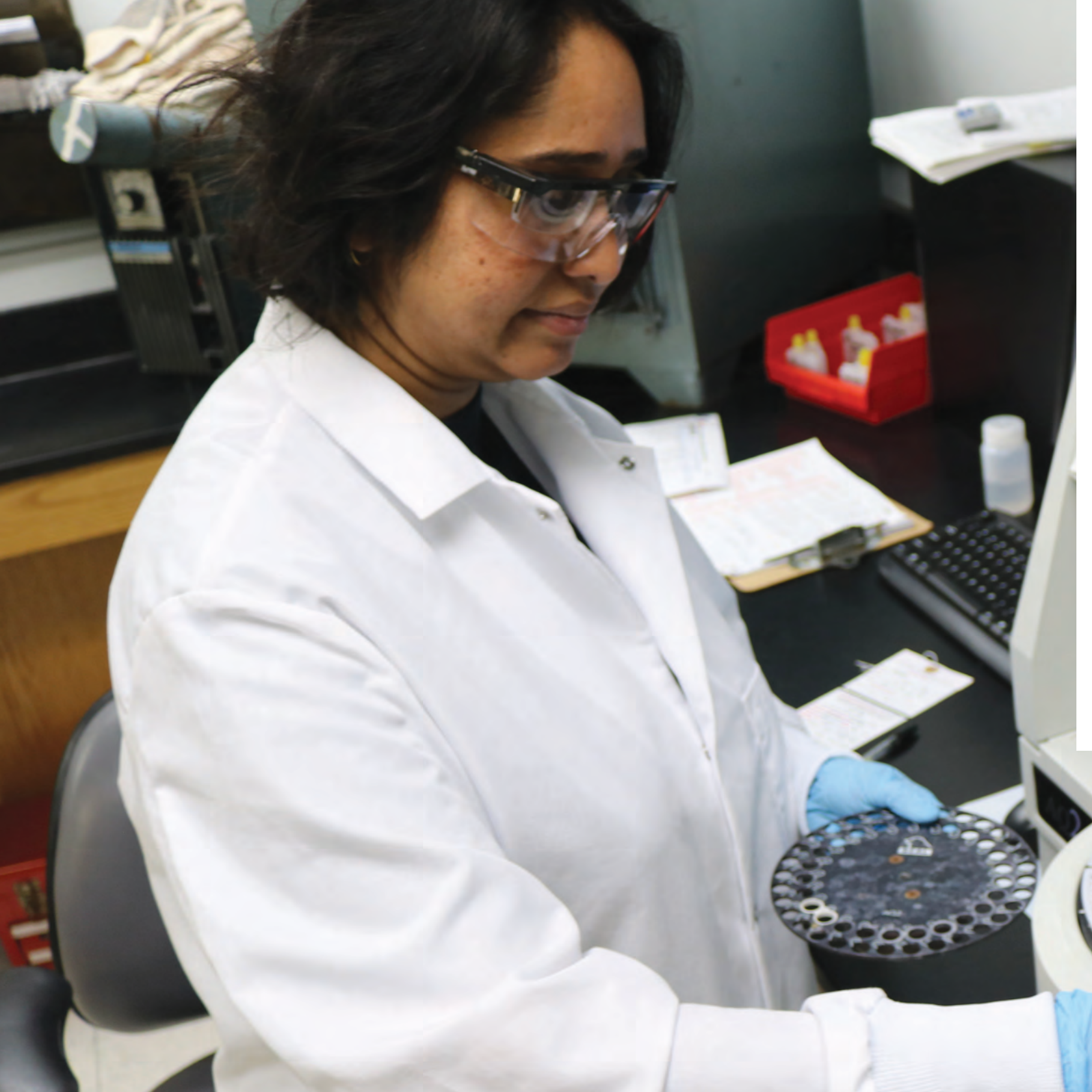
The dashboard includes three separate tabs of information in a map overlay of Nebraska. The first tab shows the number of confirmed COVID-19 cases and deaths, hospital and nursing home contacts and capacities, pharmacies, and local health director contacts. The second tab shows social vulnerability data by county, which includes socioeconomic status; household composition in terms of disability, minority status and language; and housing and transportation information. The third tab includes population densities for persons 60 years old and older by 10-year increments.

Health department leaders and medical personnel across the state review the map daily for COVID-19 updates.

The map team is working to add data categories and additional states. Once the pandemic has subsided, the map could be updated and used for other types of disasters, as well.



Screenshot of the dashboard map.



Water Sciences Laboratory (WSL) celebrates 30 years, expands offerings

The WSL marked its 30th anniversary in 2020 with new equipment, a renovated lab interior and commemorative publications. Then the global pandemic forced a reconfiguration of its operations. With numerous samples on deadline to be analyzed, the WSL balanced new safety precautions with client deliverables. The lab was among the first on-campus facilities to partially reopen during the COVID-19 shutdown.

The lab entered 2020 with a new Xevo TQS triple quadrupole mass spectrometer. The state-of-the-art device can measure contaminants with greater speed and 1,000 times the sensitivity of its older counterpart. In the fall of 2020, the WSL hosted a technical workshop with Waters Corporation, makers of the instrument, to train water professionals on its range of capabilities.

The lab continues to serve interdisciplinary faculty from multiple specialties, with the largest number of users coming from the Institute of Agriculture and Natural Resources, followed by the College of Engineering and College of Arts and Sciences. System-wide users include faculty from the University of Nebraska Medical Center and University of Nebraska at Kearney.

View the special edition Water Current featuring the WSL: ***go.unl.edu/current2020summer.***

WSL Research Lab Manager Saptashati (Tania) Biswas tests a sample in the lab.
Photo: Nebraska Water Center

2020 Faculty Fellow Research

The cutting-edge research conducted by DWFI's 122 Faculty Fellows, representing diverse disciplines across all four campuses of the University of Nebraska, greatly enhances and expands DWFI's work at home and around the world. The following examples are just a few of the hundreds of research projects that improve water and food security, as well as public health and the environment.

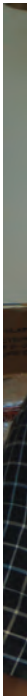
DWFI Faculty Fellow Tiffany Messer and her students install a floating treatment wetland to test its effectiveness in cleaning up algal blooms and excess nutrients from pond water.
Photo: Nebraska Water Center

DWFI Faculty Fellows lead Nebraska research in Midwestern project aimed at improving irrigation management

In November 2019, the USDA's NIFA program awarded a $900,000 grant that aims to bridge the gap between data-collection, modeling and decision-making so crop producers can more easily decide when to irrigate. The project brings together researchers from the University of Nebraska, the University of Illinois and Princeton to research ways to improve irrigation water management.

The team from the University of Nebraska includes DWFI Faculty Fellows Trenton Franz, Derek Heeren, and Daran Rudnick. They are working with partners and producers in the state to validate remotely collected soil moisture and weather data.

The team is installing on-the-ground crop sensors measuring 40 variables, including rainfall, solar radiation and plant health. Those variables combined will provide a highly accurate water and energy budget — the information a farmer needs to make a decision — available to producers through an app.



Possible solution for nitrate pollution is moving from lab to field in Nebraska

A possible solution for one form of water pollution is moving out of the lab and into the field in Nebraska, a development that could revive some unused wells and save some towns a lot of money.

Too much nitrate in water can cause infertility in humans and livestock, and it can lead to methemoglobinemia, also called "blue baby syndrome," a treatable condition in which red blood cells don't carry enough oxygen to young bodies. To avoid these difficulties, the Environmental Protection Agency has set a limit on nitrates in drinking water of 10 parts per million.

DWFI Faculty Fellow Paul Black is growing algae that feeds on nitrogen fertilizer runoff from farm fields and other sources. He believes passing nitrate-polluted water through algae and adding carbon dioxide under the right lighting for photosynthesis can solve many of the contamination problems. The algae can also then produce oil, which could be used as an alternative fuel, and other biomass material, which could be ground up and used as fertilizer.

James Allen, Mark Behrens and Paul Black in the laboratory at Nebraska Innovation Campus. Photo: Fred Knapp | NET News

A wastewater sample is collected at the Elkhorn Wastewater Treatment Plant. Photo: Anna Reed | Omaha World-Herald

Wastewater testing for COVID-19 could help predict virus surges

Recent studies have shown that those infected with the novel coronavirus shed the virus in their waste, and it can be detected in wastewater systems. DWFI Faculty Fellows Shannon Bartelt-Hunt, Jesse Bell and Xu Li, along with other university colleagues — and with assistance from the cities of Lincoln, Grand Island and Omaha — have been monitoring COVID-19 virus concentrations in wastewater samples collected weekly throughout the cities since April.

Three Nebraska cities are comparing wastewater sample data with demographic data and other known information related to the coronavirus. One goal will be to see how the wastewater tests correlate with actual cases and determine whether wastewater testing does a good job of predicting illnesses.

The amount of the virus shed in wastewater could be a leading indicator for the amount of spread within a community and give public health officials the chance to be proactive on plotting and responding to its course. By monitoring the virus in wastewater, researchers hope to detect potential outbreaks and account for those who are asymptomatic or not currently engaged with the healthcare system.

Testing the ability of "floating treatment wetlands" to filter out contaminants

Two DWFI Faculty Fellows received a major award from the USDA to study how agrochemical mixtures can be treated using engineered wetlands. The project is led by DWFI Faculty Fellows Shannon Bartelt-Hunt, professor and chair, UNL Civil Engineering; and Tiffany Messer, assistant professor, Biological Systems Engineering; as well as Daniel Snow, research professor and director of the WSL.

The four-year, $500,000 project began this summer and runs through mid-2022. A key part of the project involves Messer's mesoLAB on UNL's East Campus. The lab investigates methods to improve best management practices to treat and/or remove contaminants introduced to the environment by humans. In this case, floating treatment wetlands – artificial wetlands constructed to improve the water quality of ponds and lakes – will be tested for their efficacy in filtering out contaminants.

Ultimately, quantifying how these contaminant mixtures interact with wetlands and how wetlands absorb them is crucial to designing future versions that can protect water quality from agricultural runoff.

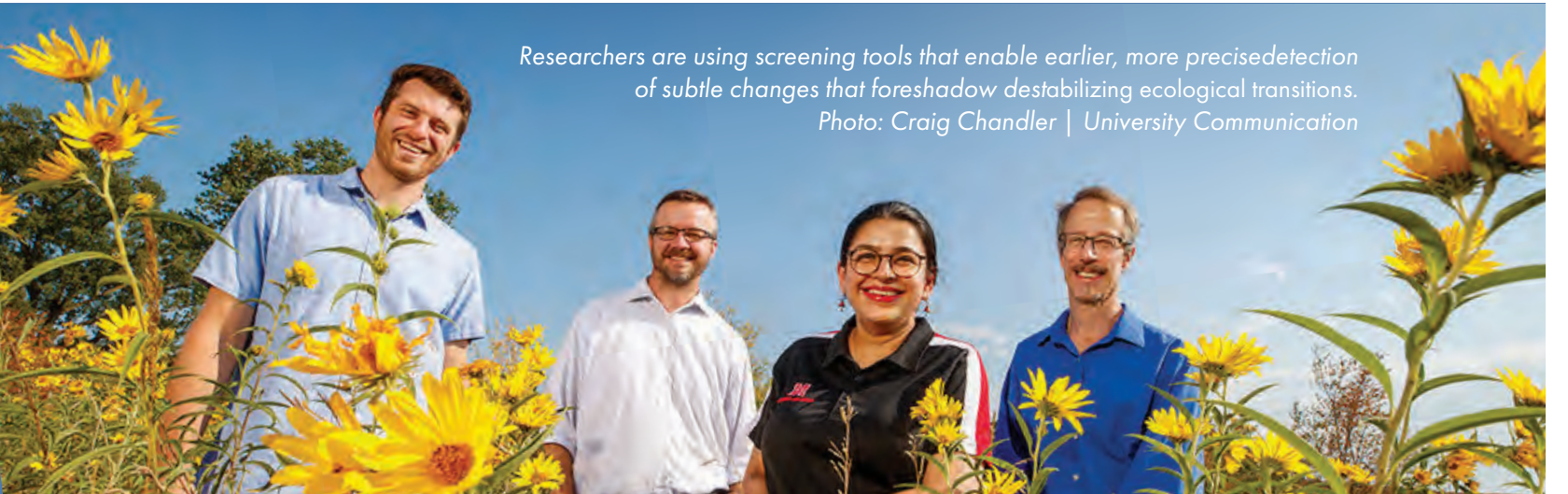
DWFI Faculty Fellow Tiffany Messer (left) and graduate student Alexa Davis stand in the Messer Laboratory, surrounded by floating wetland experiments. Photo: UNL IANR

Early detection of ecosystem change is aim of Nebraska-led research

In the field of medicine, the ability to screen for diseases before they wreak havoc on the human body has been revolutionary. The University of Nebraska–Lincoln team, including Faculty Fellows Craig Allen and Simanti Banerjee working with ecologist, Dirac Twidwell, is working to transplant this model of proactive screening to a field very different from medicine, but equally consequential: agricultural resilience, or the ability of ecosystems to withstand rapid and sudden transitions to an undesired state.

Increasingly fueled by global environmental change, ecosystem shifts – from grassland to a cedar woodland or from fertile farmland to desert – can spark chaos in communities, with consequences ranging from reduced food and water security, to heightened wildfire risks, to decreased funding for public schools.

With a four-year, nearly $4 million grant from the National Science Foundation's Established Program to Stimulate Competitive Research, the team is collaborating with University of Montana researchers to develop and implement first-of-their-kind screening tools that enable earlier, more precise detection of subtle changes that foreshadow destabilizing ecological transitions. The team will also use cutting-edge, big-data-based social science methods to identify groups most likely to adopt the tools.



Researchers are using screening tools that enable earlier, more precisedetection of subtle changes that foreshadow destabilizing ecological transitions.
Photo: Craig Chandler | University Communication

DWFI welcomes eight new Faculty Fellows

Faculty Fellows are faculty within the University of Nebraska system who contribute to the institute's research, scholarship, engagement and education programs. Faculty Fellow status provides formal recognition of an individual's accomplishments and expertise and includes the Fellow in a community of faculty with complementary interests. DWFI's Faculty Fellow pool has become increasingly competitive.

This year, eight new faculty members have accepted DWFI's invitation to become a Faculty Fellow:

Katie Anania
Assistant Professor of Art History (Modern and Contemporary), UNL

Andrea Basche
Assistant Professor of Agronomy and Horticulture, UNL

John Beghin
Professor of International Trade and Finance, UNL

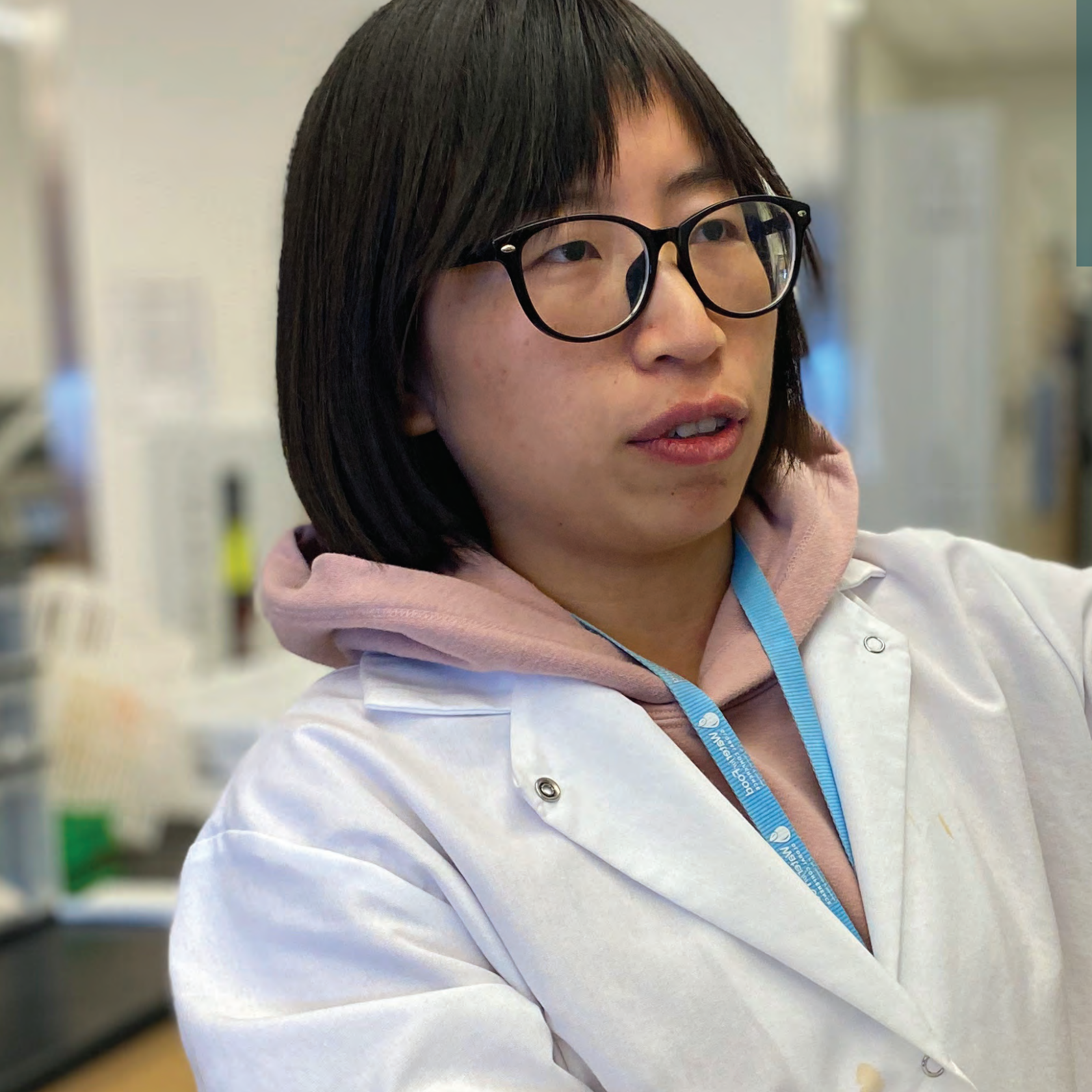
Jenny Dauer
Assistant Professor of Science Literacy; School of Natural Resources Associate Director for Teaching, UNL

Erin Haacker
Assistant Professor of Earth and Atmospheric Science, UNL

Laila Puntel
Assistant Professor of Agronomy and Horticulture, UNL

Yi Qi
Assistant Professor, School of Natural Resources, UNL

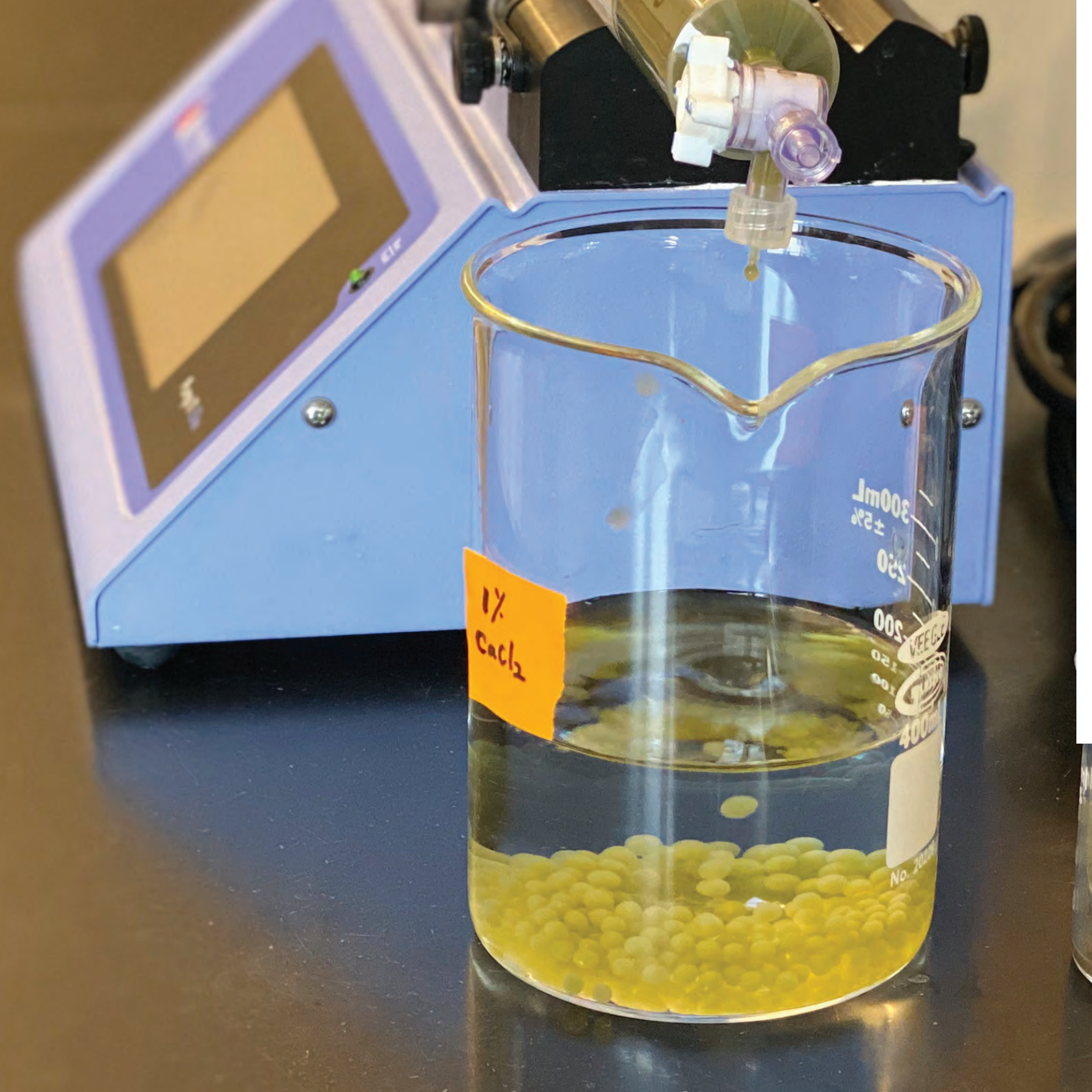
Abbie Raikes
Assistant Professor, Department of Health Promotion and Behavior, College of Public Health, UNMC



2020 Supported Student Research

Each year, DWFI leverages Robert B. Daugherty Foundation funds and additional donor funds to support graduate and undergraduate student research and creative activity. Funds are used to match recipients one-to-one with DWFI Faculty Fellow advisors. Throughout this section, you'll see a small sample of some of the work being undertaken by these DWFI-supported students.

DWFI-supported student Xinjuan Hu studies wastewater treatment using microalgae. Photo: DWFI


1%
CaCl2

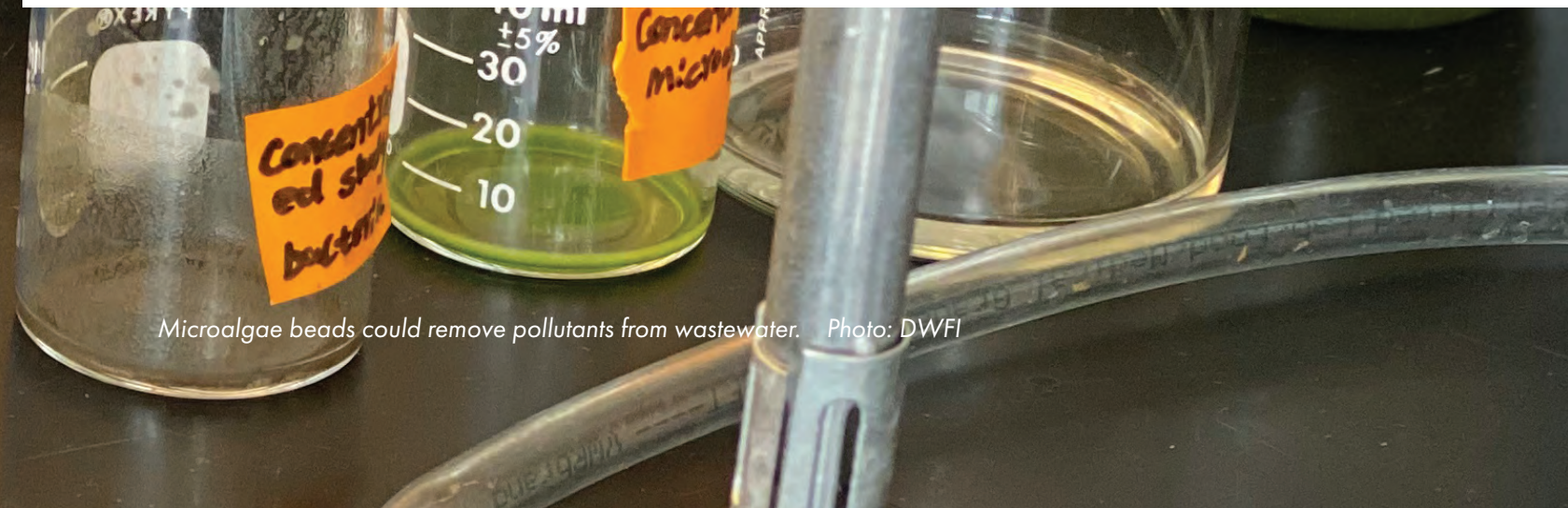
Green microalgae can treat wastewater sustainably and economically

In a new study, DWFI-supported student Xinjuan Hu and her advisor, DWFI Food Processing Specialist Yulie Meneses, found that wastewater treatment using microalgae is efficient, economic and environmentally friendly.

Similar to green plants, microalgae conduct photosynthetic growth using sunlight and CO2 and accumulate useful compounds, such as lipid, starch and protein. In the process, microalgae also can remove pollutants from wastewater, especially nitrogen and phosphorus.

However, there are a few challenges to making microalgae wastewater treatment commercially available — one of which is the complex composition of real wastewater. It often can be too harsh for the growth of microalgae, and making it less harsh can be too cumbersome for large-scale operations.

Hu found that pre-treating wastewater with chlorine improved wastewater conditions for microalgae at a low cost. Also, researchers were able to improve pollutant removal using microalgae safely entrapped in beads with symbiotic bacteria. This study shows the potential of using green microalgae for sustainable wastewater treatment in commercial operations.



Microalgae beads could remove pollutants from wastewater. Photo: DWFI

Estimating groundwater recharge in Mongolia to improve water use efficiency

While most of Mongolia's water is surface water from lakes, glaciers and rivers, 80 percent of the water used is groundwater — mostly for agriculture. Because of this substantial groundwater use, DWFI-supported student Khulan Basukh is calculating groundwater recharge at certain points and geographical zones in the country.

Basukh, a native of Mongolia, is just getting started with her study, but will eventually use meteorological and remote sensing data to better understand how factors such as precipitation, evapotranspiration and soil type can affect groundwater recharge and which factor has the most impact. Basukh will use modeling tools new to groundwater recharge research in Mongolia.

Basukh hopes her research will help Mongolian water managers and producers gain more knowledge about the water table in her home country, so it can be used to increase water use efficiency.

Lake Khovsgol National Park in northern Mongolia. Photo: Richard Mortel | Flickr

Solid-stem wheat is less susceptible to sawflies than hollow-stem wheat.
Photo: Brett Hampton | University Communications

Solid-stem wheat could reduce impacts of sawfly

Luana Machado Simão is a DWFI-supported student whose research revolves around the wheat stem sawfly in Western Nebraska and its destructive ability to eat wheat from the inside out.

Solid-stem wheat is less susceptible to sawflies than hollow-stem wheat. Through observation, this research found that solid-stem wheat varieties stood longer after harvest, with the added benefit of holding snow, which provided extra soil water content for the next season.

In their study, Simão and her advisor, DWFI Faculty Fellow Cody Creech, found that solid-stem wheat yielded less during dry conditions than other varieties and it did not stand any longer. As a result, they advise using solid-stem wheat only if the risk of impacts from the sawfly is high.

Sensor-based fertilization of corn could improve nitrogen efficiency, increase profits

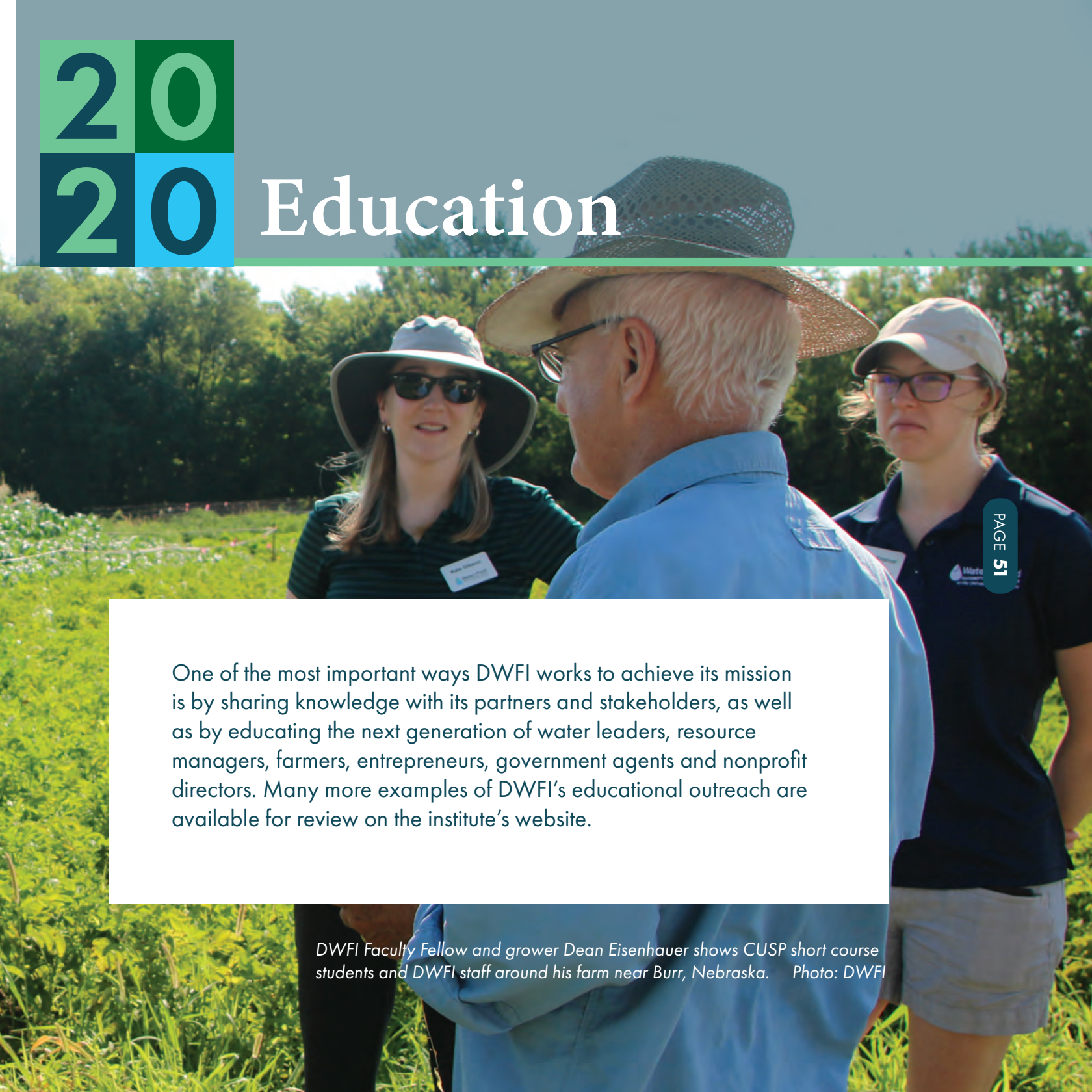
Nitrogen fertilizer use is important for generating high corn yields, but excessive use of nitrogen fertilizer can be costly for producers and harmful to the environment. In-season nitrogen application matches nitrogen availability to crop needs. Fertigation is one method of application where a farmer adds nitrogen to irrigation water, typically through a center-pivot irrigation system.

Fertigation is usually assessed based on non-quantitative methods, such as crop appearance or crop growth stage. Sensors can more accurately determine the need for and timing of fertigation, as well as quantities needed. In 2019, DWFI-supported student Jackson Stansell and his advisor, DWFI Faculty Fellow Joe Luck, used aerial imagery to determine fertigation applications at five large on-farm research sites in Nebraska. At four of these five sites, aerial imagery showed more nitrogen-efficient inputs than other assessment methods. At three of these five sites, it also was more profitable.

To make the time-intensive process more practical for widespread adoption, Stansell is working on automating the process, from image processing all the way to delivering a fertigation prescription to an in-field pump. Over the summer of 2020, the team tested sensor-based fertigation on five more sites and implemented the automated fertigation management system.

A center pivot irrigation system adds nitrogen to irrigation water.
Photo: Craig Chandler | University Communication

2020 Education



One of the most important ways DWFI works to achieve its mission is by sharing knowledge with its partners and stakeholders, as well as by educating the next generation of water leaders, resource managers, farmers, entrepreneurs, government agents and nonprofit directors. Many more examples of DWFI's educational outreach are available for review on the institute's website.

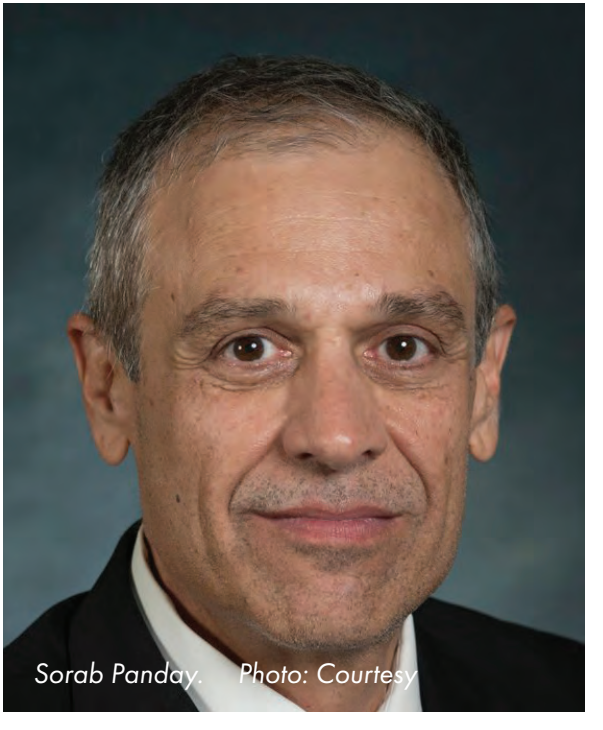
DWFI Faculty Fellow and grower Dean Eisenhauer shows CUSP short course students and DWFI staff around his farm near Burr, Nebraska. Photo: DWFI

Groundwater modeling expert shares tactics with Nebraska researchers, students

NWC successfully led an effort to bring Sorab Panday, a nationally recognized groundwater modeler, to UNL as a research professor. Key to this effort was a collaboration with the Nebraska Department of Natural Resources (NDNR), which provided travel support to bring Panday to Nebraska. Panday is the lead author on MODFLOW-USG, a groundwater flow model released by the U.S. Geological Survey.

Groundwater modelers appreciate the flexibility MODFLOW-USG offers in its grid design, which helps to focus resolution along rivers and around wells. The model identifies individual hydrostratigraphic units in groundwater. This is especially important in Nebraska, where integrated management of groundwater and surface water is a high priority.

NWC and Panday produced a workshop focused on troubleshooting advanced MODFLOW modeling issues that was attended by more than 25 state and federal partners, faculty and students. Throughout the year, Panday met with faculty, students and state partners who were facing complicated groundwater modeling issues and gave a talk as part of the NWC's Spring Seminar Series. As a result of the collaborations with Panday, these stakeholders have begun working on new modeling questions and developing grant proposals and journal articles.



Sorab Panday. Photo: Courtesy

Student support and engagement

Student support is a significant investment of the institute. In fact, it represents the single largest strategic investment DWFI makes. In FY20, student support funds are budgeted at $450,000. Faculty matches institute awards one-to-one. The institute entered the 2019 academic year with 30 active student awards.

In September, DWFI-supported students gathered for a communications workshop to learn about DWFI branding, best practices in communication, use of video and social media, and the overall importance of communicating their research to a broader audience. The workshop concluded with a networking reception attended by faculty and off-campus partners, which gave the students an immediate opportunity to apply the skills they just learned.

Each spring, DWFI showcases supported-student research at its Student/Faculty Forum. Due to the COVID-19 pandemic quarantine this year, DWFI invited students to share their research through video or online paper submissions. Many of the students produced highly engaging videos, which are posted on DWFI's YouTube channel. All research projects are available to review on the website.

SEEDS to a successful future

A DWFI team taught the second offering of the UNL Water for Food Global SEEDS (Service, Engagement, Entrepreneurship, Development, Sustainability) undergraduate upper-class learning community.

The intent of this class is to encourage interest in water and food security challenges and to cultivate future researchers, water managers and policymakers. UNL Campus Honors program support greatly facilitated SEEDS program planning.

DWFI has supported further capacity building opportunities for several groups of Rwandan UNL scholars, focusing its support on agricultural entrepreneurship and activities that complement the institute's research program in Rwanda. For example, with four Rwandan interns, DWFI staff participated in the NUtech Ventures "Introduction to Customer Discovery" course in September and October 2019.

Smallholder farmers use a solar irrigation system. *Photo: Zerihun Sewunet | UNICEF*

Webinar series shares knowledge to improve farmer-led irrigation strategies, support women and youth

As a result of DWFI's previous conference sessions and forums on smallholder farmer-led irrigation (FLI), as well as the institute's research in Rwanda examining the viability of various irrigation business models, several partners invited DWFI to coproduce and host a two-part webinar series on the topic, along with a third webinar produced as a World Water Week virtual session:

- **Accelerating inclusive farmer-led irrigation and reaching scale: key things to consider** – held June 11, 2020, in partnership with The World Bank, the International Water Management Institute (IWMI), Borlaug Institute for International Agriculture Development, et al.; focused on scaling up farmer-led irrigation.
- **Accelerating inclusive farmer-led irrigation development: a sustainable approach to reaching scale** – held July 9, 2020, in partnership with the International Food Policy Research Institute (IFPRI), Global Water Partnership West Africa, IWMI, et al.; focused on how to ensure sustainability and inclusivity as work continues to systemically accelerate scale.
- **Operationalizing farmer-led irrigation: implementers dialogue** – held August 26, 2020, as part of World Water Week, featuring implementers working in East Africa, Nigeria and Cameroon. DWFI's director of policy provided closing remarks to close out the series.

The webinars featured global experts sharing both the challenges and proven tactics for accelerating inclusive farmer-led irrigation development. The virtual miniseries explored key issues and next steps for operationalizing sustainable and inclusive FLI scale-up. All sessions garnered well over 1,000 registrants from 96 countries, and the recorded webinar videos have been viewed more than 1,300 times.

Following the success of the FLI webinars, DWFI produced another two-part webinar series focused on supporting women and youth in agricultural entrepreneurship and water management. Both webinars featured top international women leaders in water and food security, as well as DWFI-supported graduate students and staff. The webinars generated enthusiastic engagement through Zoom chat and set the stage for future collaborations with participating partners.

Recorded videos from DWFI-produced webinars are available to view on the institute's YouTube Channel: ***youtube.com/waterforfood***.

Water Advanced Research and Innovation (WARI) Fellowship Program granted three-year renewal

In 2019, the Water Advanced Research and Innovation Fellowship Program (WARI) capitalized on this program's early successes. The capacity-building fellowships provide high performing Indian students and scientists with opportunities to learn cutting-edge water science at the University of Nebraska–Lincoln.

To date, 40 Indian doctoral students and early-career faculty have completed fellowships. This year's class of 15 scholars – distributed across the four partner institutions – includes 13 doctoral students (interns) and two early-career faculty (fellows). This year's WARI participants are from 14 universities and research institutes across India. At the University of Nebraska–Lincoln, water science faculty from the departments of Biological Systems Engineering, Chemical Engineering, Civil Engineering, Food Science and Technology, and School of Natural Resources are hosting WARI fellows.

Water and Natural Resourses Tour attendees visit Three Forks, Montana. Photo: DWFI

Nebraska Water Conference

Building a clean water future in northeast Nebraska was the theme of the NWC's 2019 Nebraska Water Conference. The event – held Oct. 9 and 10 at the Divots Conference Center in Norfolk, Nebraska – connected leaders in water and agriculture from central and eastern Nebraska.

More than 40 speakers, including producers, policymakers, nonprofit professionals, university researchers, agency experts and high school students and teachers shared their work to ensure a clean water future.

2019 Nebraska Water and Natural Resources Tour

For the first time in its 48-year history, the Nebraska Water and Natural Resources Tour traveled to Montana's "Big Sky Country." Organized yearly by the Nebraska Water Center and Central Nebraska Public Power and Irrigation District, the 2019 tour blended Native American history, the Lewis & Clark expedition and a daylong excursion to Yellowstone National Park with contemporary issues in agricultural, municipal and recreational water use in Montana and Wyoming. Forty-six participants from across Nebraska joined the tour, which was held September 15–19.

2020 Spring Seminar Series

Every spring since 1968, the NWC has hosted its spring seminar series. This year, however, marked the first of this series to be transformed by a global pandemic. Titled "Current Issues in Nebraska Water," the first four seminars were held in person at Hardin Hall. The next seminar was cancelled due to the pandemic, and the final two shifted online to Zoom. The in-person seminars were well attended, but their virtual counterparts did slightly better with an average of 50 participants. Plans are underway for the 2021 series.

2020 Communication

Speaker Elisa Zancanaro Zanella is interviewed at the 2019 Water for Food Global Conference in Lincoln, Neb, USA. Photo: Chuck Zimmerman | ZimmComm

Children view their photo on the screen of DWFI Communication Specialist Frances Hayes's camera during a tour of a Rwandan farm. *Photo: DWFI*

DWFI grows stakeholders, expands reach despite pandemic

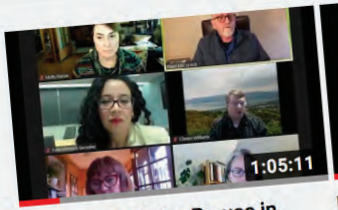
The communications team expanded DWFI's reach around the globe through posts, blogs, news releases, workshops and events, website updates, publications and more than 30 videos, including a new DWFI overview video highlighting our research, policy and education progress. The team also released a video outlining results of the Nebraska Water Productivity Report. See the DWFI website for a listing of current media mentions, blogs, news and events: **waterforfood.nebraska.edu**.

Before it became necessary to cancel plans for the 2020 Water for Food Global Conference, the communications team initiated a Request for Proposal (RFP) process to attract session entries. The response to the RFP drew more than 60 national and international responses from a wide variety of existing partners, such as IWMI, IFPRI and FAO, as well as several new entities, both public and private. A committee comprised of staff and faculty reviewed the sessions, ranking them in terms of perceived quality and value. The institute is working with the organizers of the top-ranked sessions to develop a series of water for food webinars this fall.

The DWFI communications team collaborated with the University of Nebraska Legislative Liaison Team to develop testimony supporting state budget funding to advance research in water quality and productivity in Nebraska, as described in the Development section of this annual report.

This year marks DWFI's 10th anniversary, and the communications team added an anniversary tagline to the logo and featured the decade anniversary in numerous publications. The team also collected anniversary tributes from key leaders throughout DWFI's 10-year history, which are included in the anniversary section of this report.

DWFI's social media communication promoted a wide variety of staff, faculty and student achievements in the past year, focusing on staff, faculty and student research, reports, faculty and student interviews, and messages from Executive Director Peter McCornick.

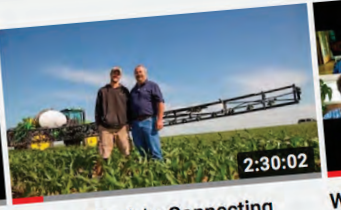


The Role of Water Re-use in Water Security | 2020 Water...

83 views • 4 days ago

Navigating State Resources for Nebraska Ag Startups

15 views • 2 weeks ago

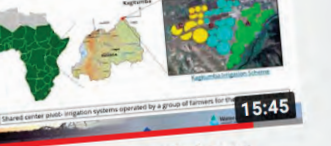


A Day at Roric's: Connecting the Acre

69 views • 3 weeks ago

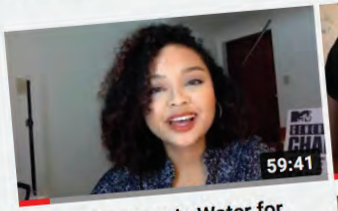
Women Leaders in Water for Food: Improving Lives and ...

86 views • 1 month ago



Water-energy-food linkages in shared smallholder...

34 views • 1 month ago



Women Leaders in Water for Food: Empowering Youth...

112 views • 1 month ago

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DWFI Research: Irrigation Business Models in Rwanda

34 views • 1 month ago

Estimating Groundwater Recharge in Mongolia by...

53 views • 1 month ago

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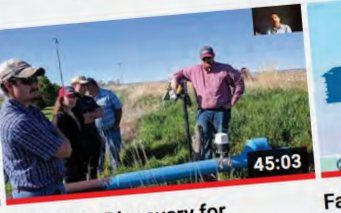
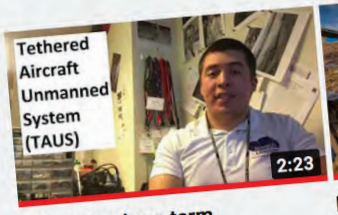


Customer Discovery for Agricultural Startups

48 views • 1 month ago

Farmer-Led Irrigation Development: Session II of ...

594 views • 2 months ago



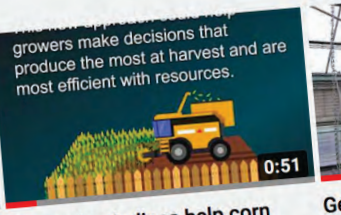
Advancing long-term persistent monitoring of cro...

Farmer-Led Irrigation Development: Session I of a...

891 views • 3 months ago

Dr. Harkamal Walia - Heuermann Chair Seminar

78 views • 4 months ago



Vegetation indices help corn growers estimate pre-harve...

50 views • 5 months ago

Genetic Architecture of Male Traits for Hybrid Wheat See...

62 views • 5 months ago

Exploring Opportunit
Incorporate Climate.

38 views • 5 months a

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Crop
Field...

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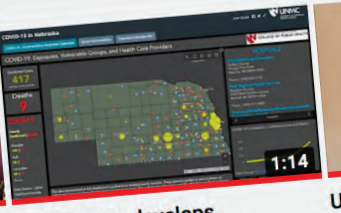

UNMC team develops COVID-19 dashboard for...

151 views • 5 months ago

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UG-LoRaWAN: Long Range Underground Wide Area...

48 views • 5 months ago

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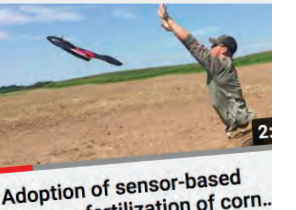

Adoption of sensor-based nitrogen fertilization of corn...

59 views • 5 months ago

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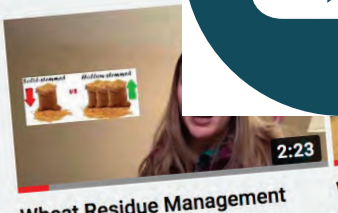
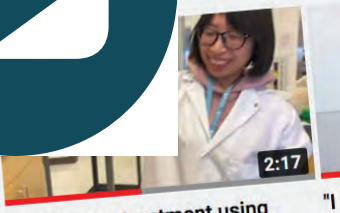


Wheat Residue Management to Enhance Soil Water...

80 views • 5 months ago



Wastewater treatment using microalgae could be efficie...

330 views • 6 months ago

CC

"I Love NU" Day - A message from DWFI's Executive...

34 views • 6 months ago

CC

Nebraska improves water productivity in livestock,...

34 views • 7 months ago

Reclaimed water safely us
in food processing

93 views • 8 months ago

CC

Social media keeps DWFI connected

DWFI's social media communication promoted a wide variety of staff, faculty and student achievements in the past year, focusing on research, reports, interviews, and messages from Executive Director Peter McCornick.

Social media impact

- **Competitor Analysis:** Compared to similar profiles, DWFI has a larger following on Facebook than most. Facebook content spreads awareness of DWFI's mission, research and activities, and it drives traffic to the website. There is a continuing opportunity to grow DWFI's following on Twitter, LinkedIn and Instagram, though the institute is on par with many similar profiles in terms of following on those platforms.
- **Social Sentiment:** People are mentioning DWFI online in an overwhelmingly positive light. This positive social sentiment shows general trust in DWFI's work and the institute's reputation online.

July 1, 2019–June 30, 2020 social media analytics

778,866
reach

13,601
engagement

25,893
video views

587,000
post views

5,164
global followers

4,300
profile visits

652,909
impressions

6,288
interactions

7,986
link clicks

661
followers

843
engagements

1,300
page clicks

DWFI supported student Osler Ortez and his research team observe corn abnormalities. *Photo: DWFI*

2020 Development

Five million dollar gift creates NU program on water, climate and health

The University of Nebraska received a $5 million gift from Dr. Anne Hubbard and the Claire M. Hubbard Foundation to create a new program addressing some of Nebraska's most pressing public health issues associated with water and climate.

The Water, Climate and Health Program is based in the University of Nebraska Medical Center's College of Public Health. The program brings together experts from the Daugherty Water for Food Global Institute and the Institute of Agriculture and Natural Resources to conduct research and disseminate information on environmental issues related to these interconnected sectors.

The Water, Climate and Health Program will work in three main capacities:

- Bring diverse university experts together to solve complex issues
- Find technical and policy solutions to improve the environment for better human health
- Provide experiences for students studying these issues

Research topics the program could address include:

- Links between the state's water quality and pediatric cancer and birth defects
- Health outcomes related to Nebraska's flooding
- The impact of technology, such as precision application of nitrogen fertilizer on soil and water quality
- Mapping of at-risk populations and environmental exposures in the state

The Hubbard Foundation's gift not only provides program start-up funds, but also supports a named professorship and graduate student research. Funds from the Robert B. Daugherty Foundation will match the Hubbard Foundation gift to support student research, enabling more students to receive research stipends. The gift also will fund outreach to Nebraska middle school and high school students and educators to engage them in issues of public health and the environment and inspire them to pursue careers in public health.

Jesse Bell, Ph.D., an expert in public environmental health who serves as an environmental science associate professor in the UNMC College of Public Health, has been named as the director for the new program. Bell will hold the Claire M. Hubbard Professorship of Water, Climate and Health. With his appointment, Bell joined the DWFI leadership team as director of water, climate and health.

Nebraska State Legislature designates funding for water research

Water is the lifeblood of Nebraska. It supports the state's $25 billion agricultural economy, sustains wildlife and the environment, and, of course, provides the water needed for healthy daily living.

Improving water management can make a tremendous difference in Nebraska's economy and quality of life for its citizens – a fact recognized when Governor Ricketts signed Nebraska's 2021 state budget bill in August. The bill designates $500,000 annually to the Daugherty Water for Food Global Institute at the University of Nebraska for water research in the state.

This state funding will help advance the institute's work in Nebraska – from drought and flood prediction and mitigation, to water quality improvement and innovative technology development that will maximize agricultural production while sustaining our valuable water resources.

With this budget allocation, the people of Nebraska have entrusted DWFI and the University of Nebraska to keep a strong water future flowing for the next generation. DWFI joins the leaders of the University of Nebraska system in thanking Governor Ricketts for signing the budget package, Senator John Stinner and the Appropriations Committee for their work on the budget, and Senator Kate Bolz of Lincoln for leading the effort to invest in water research at the university.

The Nebraska state capitol building. Photo: capitolist | Wikipedia

2010 2020 10-Year Progress Report

Cows in pasture on an autumn morning. *Photo: kovop58 | Shutterstock*

Nebraska Innovation Campus is home to the DWFI offices.
Photo: Craig Chandler | University Communications

2010 2020 Message from the President

Ted Carter

Since arriving at the University of Nebraska earlier this year, I've reflected often on what sets this place apart.

Nebraskans' collaborative spirit – our recognition that we need to work together to solve the grand challenges – is at the top of the list.

That spirit informed the creation of the Daugherty Water for Food Global Institute a decade ago. Today, that collaborative spirit continues to shine through as the Daugherty Institute and partners across our state and world work hand-in-hand to feed a rapidly growing population.

The institute's growth in 10 short years has been impressive. What began as a vision to marshal the talents of experts from the University of Nebraska, governments, nonprofits and farming and ranching to tackle one of the world's most urgent and complex challenges has turned into a global network of partners whose collective impact is changing lives every day.

Our conferences and events have engaged diverse and interdisciplinary teams of experts, all working toward a common goal. Our exchange programs have allowed faculty, staff and students from around the

globe to study with and learn from each other. Our collaborative research has greatly advanced our understanding of water use in agriculture and has led to new strategies for feeding an increasingly hungry world.

I'm grateful to my University of Nebraska colleagues and our partners who have been a part of this effort, to the philanthropic community who invested in our vision from the start – and, especially, to the farmers and ranchers in Nebraska and around the world who do the hard work every day to put food on our tables.

The urgency of the Daugherty Institute's mission has only grown. Too many of our fellow humans still face hunger, thirst and poverty. The future health and well-being of our global population demands creative, collaborative solutions.

The University of Nebraska, through the Daugherty Institute, is proud to play a leading role. I look forward to seeing what we will achieve together in our next 10 years.

Ted Carter
President, University of Nebraska System

DWFI is one of three interdisciplinary, institutes at the University of Nebraska. Photo: Craig Chandler | University Communication

2010 2020 10-Year Timeline

The history of the institute

The Daugherty Water for Food Global Institute is in full stride, working in concert with a powerful network of state, national and global partners who are all committed to ensuring water and food security for future generations. It is nearly impossible to compile a list of all the impactful projects the institute has developed and supported in the past decade. The following timeline reflects a sampling of the institute's varied and innovative achievements. DWFI's annual reports, as well as other publications from DWFI staff and affiliated faculty, are available to read and download from the University of Nebraska–Lincoln Digital Commons: **digitalcommons.unl.edu/wfflit**.

The founding of the institute

"The test is not research and policy papers that end up in archives in educational institutions. We'll know this has been a success if 5 years from now, or 10 years from now, you go somewhere in the world, and they say, 'We had a problem with water; we contacted the Daugherty Water for Food Institute; they helped us out; and we solved our problems.' That will be success." - Mogens Bay

The full story behind the institute's founding is available at **go.unl.edu/DWFIstory.**

2009

- Mogens Bay, chairman of the Robert B. Daugherty Foundation, met with JB Milliken, president of the University of Nebraska, to share Bob Daugherty's vision of a global research institute focused on improving water use in agriculture to ensure food security
- To gauge interest in the institute, the University of Nebraska hosted its first Water for Food Global Conference in 2009 in Lincoln, Nebraska. Attracting high-level speakers from around the world and many attendees, University of Nebraska leaders knew this was a valued concept to help address an urgent global need

2010

- The Robert B. Daugherty Foundation made a $50 million gift to the University of Nebraska Foundation to fund the Daugherty Water for Food Global Institute

Mogens Bay

Chairman, Robert B. Daugherty Foundation
Board Director, Daugherty Water for Food Global Institute

"When we first started the Daugherty Global Water for Food Institute 10 years ago, my concern was whether we would become a relevant voice in the global dialog to protect and stretch the world's freshwater resources for food production.

That concern turned out to be unfounded. There is not a major conversation taking place globally regarding freshwater for agriculture without the Daugherty institute being at the table.

2011

- Began recruiting paid faculty to lead water and food security research
- Hired Marc Andreini, a civil engineer and hydrologist, as a senior research scientist
- Hosted the 2011 Water for Food Global Conference, "Paths to Solutions"
- Started the Faculty Fellow program, recognizing and supporting faculty who shared the institute's focus on water and food security from a variety of research disciplines
- Established UNESCO-IHE double degree program with UNL. The degree students receive from UNESCO-IHE is the MSc degree in Water Science and Engineering with a specialization in Land and Water Development. UNL awards the MS degree in Agricultural and Biological Systems Engineering, with a specialization in Advanced Water Management for Food Production

- Prem Paul, vice chancellor for research and economic development, and his staff assumed much of the early work of the institute, including conference planning
- A search committee began worldwide recruitment for the founding executive director and other key leadership positions
- Hosted the 2010 Water for Food Global Conference, "Water for Food: Growing More with Less"
- Hired Rachael Herpel as a research and outreach coordinator, first member of DWFI staff

The next priority became how we could best add value. I have been impressed with the global partnerships we have developed through our conferences, projects and research that has advanced our understanding of, and response to, improving water use in agriculture.

The proof that we will have accomplished Bob Daugherty's vision is this: If somewhere in our country, or throughout the world, governments or public agencies would say, "We had a real challenge managing our freshwater resources for agriculture and turned to the Daugherty Global Water for Food Institute for help. They assisted us with technology and policy development, and we have successfully addressed our challenge." That is what success looks like in my opinion.

2012

- Hired Roberto Lenton, former director general of the International Water Management Institute, to lead the institute as its founding executive director
- Hosted the 2012 Water for Food Global Conference, "Blue Water, Green Water and the Future of Agriculture"
- Incorporated the Nebraska Water Center and Water Sciences Lab into DWFI
- Recruited more Faculty Fellows and enhanced their development
- Started building communications capacity with website, social media, print materials
- Started establishing partnerships and leveraging funding
- Co-hosted policy events internationally and in Nebraska: World Water Week, World Water Forum, Institute on Science for Global Policy conference in Nebraska

2013

- Prepared a clear strategy to guide the institute's work
- Hired Chittaranjan Ray as director of the Nebraska Water Center
- Hosted the 2013 Water for Food Global Conference, "Too Hot, Too Wet, Too Dry: Building Resilient Ecosystems"
- Expanded Global Yield Gap and Water Productivity Atlas to include several new countries
- Increased the number of Faculty Fellows and supported research
- Hired Christopher Neale as director of research
- Built partnerships with global agencies, such as The World Bank, the International Water Management Institute and the Food and Agriculture Organization of the United Nations

2014

- Rounded out the DWFI leadership team with the hiring of Nicholas Brozović as director of policy and Molly Nance as director of public relations and communications
- Moved into new office space at the recently built Nebraska Innovation Campus
- Developed a strong set of collaborations with national and international partners, balancing work in Nebraska with global outreach, including in India, Brazil, China and selected countries in East Africa and the Middle East and North Africa region
- Convened policy dialogues, workshops and seminars
- Initiated the Water for Food Institute Student Support Programs for undergraduate, graduate students and postdocs working with Faculty Fellows on subjects related to the institute's mission
- Developed 2015-2020 strategic plan
- Hosted the 2014 Water for Food Global Conference, "Harnessing the Data Revolution: Ensuring Water and Food Security from Field to Global Scales," in Seattle, Washington

2015

- Established the Water Advanced Research and Innovation (WARI) fellowship program for Indian students with the Indo-U.S. Science & Technology Forum and UNL
- Developed the Water for Food entrepreneurship accelerator
- Held the first annual Student Support Research Forum
- Collaborated with FAO to develop a remote sensing-based water productivity product and to establish a regional platform to serve these products in the MENA region
- Partnered with IARI on drought monitoring, irrigation efficiency, and improving drought and salt tolerance of crops
- Convened sessions at the World Water Forum, World Water Week and co-hosted a significant conference on water quality trading with the USDA and EPA that brought more than 200 state and federal government and private sector attendees to Lincoln
- Began the Water for Food Global Institute Undergraduate Intern Program, providing internships to highly qualified students
- Enhanced communications strategy with focus on video, targeted social media and improved website navigation

Felicia Marcus

Member, Water Policy Group
Board Director, Daugherty Water for Food Global Institute

“Congratulations on a superb 10 years of service to the world. In an amazingly short time, the Daugherty institute has become a well-recognized and well-regarded international institution and a go-to source of inspiration and practical best practices. Their research and innovative spirit are what the world needs more of in facing an increasingly unpredictable future, where efficiency in agricultural water use will help maintain agricultural productivity while also protecting the natural world.

2016

- University of Nebraska Regents selected Hank Bounds as president of the University of Nebraska. He joined the DWFI board of directors
- Hosted the 2016 Water for Food Global Conference, "Catalytic Collaborations: Building Public-Private Partnerships for Water and Food Security"
- Added 18 Global Fellows, external to the University of Nebraska, whose geographic locations strengthen the institute's global influence
- Launched the GloDET satellite based ET monitoring project with the Nebraska Drought Mitigation Center, with funding from USAID through ICBA
- Supported a student study tour of water scarcity and research in Amman, Jordan
- Began research with partners on the NIFA-funded Ogallala Water Coordinated Agriculture Project (OWCAP) project to support crop and livestock production and sustain the communities of the High Plains region
- Created "NRD Stories," an oral history of Nebraska's Natural Resources Districts
- With FAO and the University of Manchester, DWFI developed AquaCrop-OS, which enables rapid analysis of crop yield response to water
- Roberto Lenton transitioned to a faculty role and Peter G. McCornick, deputy director of the International Water Management Institute, accepted and assumed the position of Executive Director, Daugherty Water for Food Global Institute.
- Became a founding member of the Global Framework on Water Scarcity in Agriculture (WASAG), an international partnership, hosted by the Food and Agricultural Organization of the UN, aimed at addressing water scarcity in agriculture

2017

- DWFI and Faculty Fellow research projects expand across the Midwest, California and 77 countries
- DWFI hosted the 2017 Water for Food Global Conference, "Water for Food Security: From Local Lessons to Global Impacts"
- Entered into a new partnership with the Association of Irrigators and Farmers of the State of Bahia, Brazil (AIBA) to support the sustainable expansion of irrigated agriculture in southwest Bahia, exploring the region's Urucuia Aquifer System as the water source
- Developed a joint EDF/DWFI report to identify the best management practices for incentive-based groundwater management in the Western United States
- Co-led a project with Faculty Fellows using VRI, drones and remote sensing technology to help farmers increase food production, while conserving water and energy, using a combination of soil water content monitoring, remote sensing from drones and satellite systems and modeling
- CK Duryea joined the institute as its first director of development
- NWC coordinated research targeting the shallow vadose zone, or unsaturated zone, to gain insights on how nitrates accumulate and move through groundwater. The data will help cities and NRDs learn

Hank Bounds

Executive Coach, Bounds Bailey LLC
Faculty, University of South Alabama
Former President, University of Nebraska
Board Director, Daugherty Water for Food Global Institute

how to manage and mitigate contamination

- DWFI invested in a new Water for Food Processing Initiative to help the private sector optimize water use in food processing and reduce waste in food, water and energy
- In partnership with the Indian Agricultural Research Institute (IARI), DWFI began development of an agricultural drought monitoring and early warning system for India

“On this 10th anniversary of the Daugherty Water for Food Global Institute, I think it important to pause for a moment and express appreciation for the incredible work of a truly global team of researchers. The institute’s scientists wake up every day focused on how to improve water and food security for more than 7.5 billion people. I count it as a privilege to have had the opportunity to work with such a talented group of scientists who are dedicated to changing the world.

What started as a conversation between President J.B. Milliken and Valmont CEO Mogens Bay has turned into an institute that is working in dozens of countries, has advanced our understanding and response to improving water use in agriculture, and has produced policies and practices that have enhanced water management and governance. My sincere thanks to the Daugherty Foundation for its investment and vision to create a water and food secure planet.

Howard W. Buffett

Associate Professor & Research Scholar, Columbia University's School of International and Public Affairs
Board Director, Daugherty Water for Food Global Institute

"There are few efforts that carry more global significance than the mission of the Daugherty Water for Food Global Institute. For the past 10 years, DWFI has worked tirelessly to ensure society's ability to sustainably address our world's food security challenges. The institute plays a critical role in bringing attention to the importance of water resources and water resource management for increased agricultural productivity. Further, DWFI is unique in its reach across all scales of output, ranging from smallholder farmers using basic irrigation tools to boost yields and to double crop, to large high value and row crop farmers working to more effectively manage crop irrigation to avoid aquifer depletion.

To deliver its mission, DWFI has gone far beyond applying its research into the field. The institute provides its expertise and uses its far reach to build meaningful partnerships across government agencies, NGOs, philanthropy, private industry and other universities around the world to collaborate and advance much needed innovation.

I would like to take this occasion to thank and congratulate all who have been a part of the Daugherty Water for Food Global Institute and its continuing success. I look forward to what the next 10 years will bring.

2019

- Hosted the 2019 Water for Food Global Conference, "Water for a Hungry World: Innovation in Water and Food Security"
- Completed the Nebraska Water Productivity Report, which reflects significant improvements in yield per drop of water used for crops, livestock and biofuels over the past three decades
- Participated in flood management workshops to address Nebraska's

2018

- Updated the strategic plan for FY2018-2023
- Leaders of the World Bank, USDA and USAID invited DWFI to co-convene a conference, hosted at the World Bank in Washington, D.C., focused on expanding sustainable irrigation in developing countries
- Became a founding partner in the formation of the Irrigation Innovation Consortium, a strategic collaborative research effort designed to accelerate development of water and energy efficient irrigation technologies
- Collaborated with students in the Raikes School Design Studio at UNL to develop new data analysis and visualization tools in a farm database dashboard
- A Nebraska delegation of university and DWFI leaders and faculty visited Bahia, Brazil, to collaborate with AIBA, focusing on achieving a significant economic impact and improved water and food security in Bahia
- NWC and WSL initiated the "Know Your Well" program, an educational project started at NU that engages high school students and teachers in sampling and testing groundwater quality
- With FAO, planned and convened the water for agriculture track at the World Water Forum in Brazil
- Executive Director McCornick was elected to the World Water Council's board of governors
- Received a significant gift from the Ivanhoe Foundation, which is eligible for matching additional gifts for student research
- Redesigned the DWFI website, creating a more visually compelling and mobile-friendly design

historic flooding and its impact on agriculture and water quality

- Further developed a flux tower system across Nebraska to provide real-time ET data to farmers, NRD managers, scientists and others through the Parallel 41 website
- Initiated research in the Bazile Groundwater Management Area (BGMA) in Northeast Nebraska, working with four Natural Resources Districts (NRDs) to mitigate and manage nitrate contamination
- Collaborated with the Institute for Agriculture and Natural Resources to research irrigation business models in Rwanda, collecting data to support scaleable solutions
- Worked with Raikes School students to solve connectivity problems with soil moisture smart meters. The students' well-designed solution won the Raikes School Platinum Project award for best project
- Developed "SEEDS," an upper-class learning community at UNL focused on global entrepreneurship, agriculture and sustainable development, which included a three-week experiential study trip to Rwanda
- Produced a video featuring donors Robert and Karla Baltzell and their Student Innovator Fund, which garnered more than 8,200 views on Facebook alone
- Published an interactive map called UNDA, providing high-level information about projects, including description, focus area, status, start and end dates, country and people involved

2010 2020 Tributes

Mike Johanns

Former United States Senator, Nebraska
Former Secretary of Agriculture, United States
Former Board Director, Daugherty Water for Food Global Institute

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It is truly an honor for me to offer my congratulations to the Daugherty Water for Food Global Institute on its 10th anniversary. I could not be more excited about all that has been accomplished by the institute in the last 10 years. It is safe to say that any discussion about water worldwide will include the Daugherty Water for Food Global Institute. This has happened in just 10 years of existence.

The reason why is because, from the very beginning, the institute reached out worldwide to create partnerships. Further, the world class research and policy proposals of the institute have shown over and over again that it rightfully deserves a place at the table.

As I think about agriculture in the future, I can't help but think that water use will be the key issue as we search for ways to feed a growing world population. I am confident that with continued leadership from the Daugherty Water for Food Global Institute we will meet this challenge in the years to come.

J.B. Milliken

Chancellor, The University of Texas System
Former President, University of Nebraska
Board Director and Founding Chairman,
Daugherty Water for Food Global Institute

In 2010, Bob Daugherty, visionary philanthropist and businessman, approved an extraordinary gift of $50 million for the establishment of a global institute at the University of Nebraska to focus on the sustainable and efficient use of water for food production. Worldwide food production and related agricultural activities represent approximately two-thirds of freshwater usage annually. Bob recognized that there is no greater way to sustain freshwater resources than to invest in scientific research and innovation, public education and policy advocacy that ensures efficient use and protection of one of life's essential anchors. Bob spent his career pioneering an industry based on this premise, and he considered it his life's work – and the new institute is his legacy gift to the world. Sadly, Bob died before he could see the impressive progress the Daugherty institute has made in its first 10 years for the people of the world, but his legacy is intact.

In considering its accomplishments, we often think first of the institute's convening functions and its educational activities that prepare leaders in science and policy development. But I believe Bob would be exceedingly proud and gratified, as am I, of the essential research for good the institute supports. For example, the institute underwrites work to improve water quality for public health, to capture the critical role of rivers, like the Platte, in keeping the natural environment vibrant, and to close the yield gap for food and commodity crops in more than 70 of the world's most important food producing countries. Research support is central to the institute's global reputation as a leader in the sustainable use of water for agriculture. I consider it one of the rare opportunities of my life to have met Bob, learned about his interest, and helped provide a way to achieve his vision. Bob's generosity and foresight have made the institute one of the crown jewels of the university, and I am excited about what the next 10 years will bring.

Jeff Raikes

Cofounder, Raikes Foundation
Former Chair of the Board and Director, Daugherty Water for Food Global Institute

How will the world ensure the food security of 10 billion people by 2050? Water is the foundation for food security. And agriculture consumes 70% of global water resources on average, with pressures on demand likely to increase. By improving water efficiency in agricultural productivity, we support sustainability, increase yields and improve lives and communities. This was the vision that spurred the creation of the Daugherty Water for Food Global Institute (DWFI) in 2010.

I am enormously proud to have played a role alongside the Daugherty Foundation, Mogens Bay, J.B. Milliken, the leadership and faculty of the University of Nebraska, and many others, to create DWFI. Our original idea was to connect world-class research with stakeholders working on water security challenges in government, in the private sector and across the NGO landscape. On the 10th anniversary of DWFI, I am deeply gratified to see the contributions DWFI has made.

I am optimistic for DWFI's next decades of global impact. The institute is well positioned to spur transformation efforts spanning the public and private sectors. With its talented team and global reach, DWFI will continue to spark innovations, expand the base of knowledge and engage with cross-sector partners in catalyzing and scaling systems change to achieve global water and food security.

The challenges are many and familiar to the DWFI community. Climate change threatens natural resources and public health. Economic disparities are widely felt across the world, against a backdrop of sociopolitical uncertainty and a concerted fight against racial injustice and racism in all its forms. DWFI's work is inextricably linked to these and other global challenges. Having grown up on my family's farm not far from the University of Nebraska, I remain steadfast in my belief that agriculture and water resources lay the foundation for social prosperity and vibrant communities.

Anchored by DWFI's team and the University of Nebraska, and with your support and engagement, I am optimistic for our future – a world with dinner at every table and water in every glass due, in part, to DWFI's global leadership, innovation and strong partnerships.

Ronnie Green

Chancellor
University of Nebraska–Lincoln

“It is hard to believe that we are at the decadal mark in the history of the Daugherty Water for Food Global Institute (DWFI) at the University of Nebraska. I especially relate to it personally, as I came home to the University of Nebraska–Lincoln at the very time the institute was being formally launched here in 2010 by the tremendous vision and generosity of Bob Daugherty through the foundation bearing his name. To see the institute bear such tremendous fruit in its first decade – from becoming the primary international convener of everything to do with “water for food security,” to significant expansion of water research, education and policy efforts in Nebraska via the Nebraska Water Center, to the multitude of major partnerships across the globe in India, China, sub-Saharan Africa, Indonesia, Brazil and Argentina, as well as with the IHE Institute for Water Education, while becoming a leading voice in the World Water Forum – could not be more exciting. I had the pleasure of helping to build many of those international partnerships, and it is so gratifying to see them now maturing and having impact. I have no doubt that Mr. Daugherty would be pleased to see the thought leadership in this arena now rightly coming from Nebraska’s people’s university and emanating around the globe through the institute’s reach. Happy 10th anniversary, DWFI — here’s to an even more successful decade ahead!

Michael Boehm

Vice Chancellor, Institute of Agriculture and Natural Resources, University of Nebraska–Lincoln
Vice President for Agriculture and Natural Resources of the University of Nebraska System

DWFI is truly the center of all things water at the University of Nebraska. It is the magic of combining Nebraska's investment in water with our long, internationally recognized agricultural research efforts. Through the institute's leadership, Nebraska has become a major global partner in achieving water and food security in this century.

DWFI has achieved incredible momentum in its first 10 years, helping focus Nebraska's efforts to improve agricultural and livestock production by using water effectively and more sustainably. The institute understands there is no one-size-fits-all program for improving water productivity, but rather, cultivates best practices to improve productivity suited at the local level, wherever that might be. That could include using drone imagery to create irrigation maps for thousands of acres in central Nebraska or encouraging low-cost irrigation options to farmers in developing parts of the world.

Water security supports food security, which together support national security. Water security is the cornerstone for all other human needs and enhances quality of life through improved health, higher income and better opportunities for education and employment. DWFI is meeting its mission to improve the human condition through its research, policy and educational work to ensure water and food security for our world.

Harvey Perlman

Professor, College of Law, University of Nebraska–Lincoln
Former Chancellor, University of Nebraska–Lincoln

“I think all of us involved in establishing the Daugherty Institute sensed its potential as an initiative that gave the University of Nebraska a unique opportunity. I was, however, surprised with how quickly we were embraced by the other international water organizations, as well as countries faced with the serious issues of water for food. I had the personal experience of participating in the institute’s engagement in the Middle East and in Indonesia and seeing firsthand the practical implementation of best practices derived from the institute’s expertise. Ten years of integrating academic research with the practical experience of Nebraska farmers and ranchers in managing water resources has made a real impact on the world.

Loïc Fauchon

President
World Water Council

Since its inception, 10 years ago, the Daugherty Water for Food Global Institute has been a very active member of the World Water Council. The high level of research developed by the institute within the University of Nebraska has been widely recognized by the main representatives of the water community in the world on its relationship with agriculture.

During the last 10 years, the relationships between the DWFI and the WWC have been very active and the institute has participated in a great number of jointly organized conferences, as well as the last three World Water Forums, which were held in France, Korea and Brazil.

The World Water Council was also more than happy to participate in the 9th Water for Food Global Conference organized by the Daugherty institute in Lincoln, in 2019, which was very successful and valuable with 400 specialists from 15 countries.

Water for food is a key priority for the World Water Council. The World Water Council and the Daugherty Water for Food Global Institute share the same objectives of international advocacy, as we both know that water is the main element to secure food for the future of mankind.

Our joint projects are aimed to promote solutions and responses for the sustainable and equitable development of humans on earth. The main research projects developed by the institute have clearly advanced our understanding and response to improving water use in agriculture. The institute has also contributed to focus on the necessity to adopt policies and best practices to improve water management and governance at global and local levels.

On my personal behalf, and on behalf of the 400 members from more than 50 countries of the World Water Council, I would like to thank Professor McCornick, executive director, for his everyday commitment to the international advocacy of water for food.

Melissa Ho

Senior Vice President, Freshwater and Food
World Wildlife Fund – U.S.

Agriculture and food systems are at the intersection of global policy agendas around sustainable development goals, climate change and biodiversity. Over the past decade, the delicate balancing act between agricultural and environmental needs, the two main uses of freshwater, has only intensified. Now, more than ever, the mission and work of DWFI is critical to the work of conservation. I have personally appreciated seeing how the institute has grown and evolved since its inception. The World Wildlife Fund values the partnership with DWFI because of a shared approach of convening multi-stakeholder forums, which elevates local and regional challenges and solutions that have global and international relevance and impact, all the while being grounded in science. By 2030, humanity must address the critical challenge of securing enough food and nutrition for a growing population, within planetary boundaries. WWF looks forward to working with DWFI and others in the coming decade to advance the ideas and innovations needed to meet this goal.

Roberto Lenton

Chair, IWMI Board of Governors
Professor Emeritus, University of Nebraska–Lincoln
Founding Executive Director, Daugherty Water for Food Global Institute

“

I am truly delighted to join in celebrating the 10th anniversary of the Daugherty Water for Food Global Institute at the University of Nebraska. For me personally, it is always a treat to read the institute’s newsletters and reports and to learn about the many innovative research and policy activities DWFI is engaged in, the way in which its visibility, influence and impact is expanding both in Nebraska and around the globe, and the growing amounts of funding it is attracting. The institute has achieved so much in its first decade and will surely achieve even more in the years and decades to come.

I am particularly proud that in these 10 years DWFI has clearly fulfilled Bob Daugherty’s vision of an institute that draws on Nebraska’s vast experience and leadership in water governance and management to solve challenging problems both locally and across the world. One of the secrets of the institute’s success, in my view, is the way it not only helps to pull together faculty of different disciplines from across the university but also provides opportunities to bring together a range of actors: farmers, company representatives, government policymakers, researchers, and others from across Nebraska and the world, to figure out ways to solve problems of common concern. I have always loved participating in the institute’s Water for Food Global Conferences for precisely this reason – to see firsthand the way in which the institute brings people together to discuss challenging problems, develop a better understanding of one another’s perspectives, forge lasting partnerships – and jointly help create a better world.

Eduardo Mansur

Director, Land and Water Division
Food and Agriculture Organization of the United Nations

The Food and Agriculture Organization (FAO) has witnessed the role that the Daugherty Water for Food Global Institute (DWFI) increasingly has played since its inception, in providing scientific leadership in the State of Nebraska and on the international scene, as an authoritative partner who contributes to the global agenda for sustainable agriculture water management. The institute is a valuable and well-recognized partner working with global players such as the CGIAR Centers, the World Bank and FAO. We are pleased to learn that DWFI work covers more than 70 countries, engaged in research, education, policy and projects on the ground, providing solutions that combine water use efficiency and environmental sustainability for food and agriculture. In this particular time of a global pandemic, the role of DWFI to help advance the global commitments towards the SDG 6 – water and sanitation for all – cannot be overemphasized.

The DWFI convening power is evident through the Water for Food Global Conferences, which have become the event where many global leaders in research, academia, business, civil society and agriculture converge annually to discuss solutions to water, food security and nutrition challenges.

We are particularly pleased with the institute's commitment toward the Global Framework on Water Scarcity in Agriculture (WASAG) hosted by FAO, and of which DWFI is a founding partner. DWFI has been elected twice by the WASAG Partners to continue to serve on the Steering Committee, in recognition of the contribution that it brings as witnessed by the active participation of its experts in the different WASAG working groups, particularly on Sustainable Agriculture Water Use, Drought Preparedness, and Water and Nutrition.

FAO looks forward to our continued collaboration. Happy celebrations of your 10th Anniversary, with the certainty of many more successful years ahead!

Letitia Obeng

International Consultant
International Advisory Panel,
Daugherty Water for Food Global Institute

There is no food security without water security. So, the goal of ensuring both was indeed a visionary step forward 10 years ago when DWFI was founded. Over the past 10 years, the institute has grown from strength to strength, positioning itself strategically in the water and food worlds as it strives towards achieving that goal. I have watched the growth of the institute, initially from afar. Three areas have particularly stood out for me:

The institute has very successfully engaged both in the domestic (USA) and international water and in agricultural worlds. It has built strong partnerships within the U.S. and formed alliances with a broad range of international partners – bringing its unique perspective to dialogue and action around water and food security. It now has a strong and growing voice in the global arena.

The flagship conferences have attracted more and more active stakeholders, bringing together local and international, as well as south-north perspectives and knowledge. Many rich presentations and dialogues have led to new partnerships among the diverse conference participants. Big and small-scale farmers sit and discuss with scientists, government officials, development activists and students; all learning from each other, focusing on innovation and how to build resilience in this climate stressed world while enjoying the time spent with each other. This was very much my impression during my first conference in 2019.

And finally, I believe the focus on data and technology to help with managing water and improving food production has continued to successfully evolve. The tools and systems developed are important for farmers, researchers, policy- and decision-makers alike.

This first 10 years have been so productive. I wish the institute even more growth and success towards its goal in the next 10.

Jennifer Sara

Global Director, Water Global Practice
World Bank

Today we mark the significant milestones that have been reached with regard to water in agriculture since the Daugherty Water for Food Global Institute's inception 10 years ago. DWFI and the World Bank have worked closely together on numerous conferences and projects, as well as on research that underscores the importance of improving water use in agriculture. This research has subsequently been used to develop improvements in water management and governance across the world.

The partnership between the World Bank and DWFI, under the leadership of Peter McCornick, has included numerous collaborations in water and food spaces, such as serving together as members of the World Water Council and advancing important global and regional dialogues on the development of farmer-led irrigated agriculture. Given the unprecedented global macroeconomic impacts of COVID-19, coupled with pre-existing climate, hunger, nutrition and fragility challenges, the World Bank and DWFI will continue to work together to sustain water resources, deliver services, strengthen food systems and build resilience in the developing world.

2010 2020 Original Research Cohort

Specialized collaborations achieve more than the sum of their parts

When the institute launched in 2010, the University of Nebraska already boasted a large, respected contingent of agriculture and irrigation scientists. It was exciting to imagine what they might accomplish to support the world's water for food goals. However, researchers tend to work independently and are often unaware of one another's work.

DWFI's solution, in partnership with IANR, was to hire a specialized "cluster" of researchers who would focus their research on specific water for food issues. For the institute's 10-year anniversary, we checked in with our original faculty hires to see how their work has developed over the last decade – and to learn how they see future research evolving. The researchers confirmed that many of their groundbreaking advancements in science, technology and policy would not have happened without DWFI's support.

Crop growth and development: knowledge unfolding through generations

Since the first farmer planted seeds to grow food, humans have studied plant growth and ways to make farming more productive. Today's sophisticated research includes the study of crop phenology – how plant development is affected by many factors in varied cropping systems. Roger Elmore, an original DWFI researcher, devoted his career to this study.

Roger Elmore

UNL Agronomy & Horticulture Emeritus Professor & DWFI Charter Research Fellow

"After all these years of studying crop phenology, we are still amazed what we can learn, and need to learn, about how crops grow," he said.

In 2016, the world became aware of shocking proof that we need to study crop development: issues with corn ear development. Some fields were yielding two-thirds less than expected.

Through research, Elmore and others discovered it is likely a cascade of events, from genetics and the environment to management systems, along with event timing, that triggers ear development problems. It was exciting research, he said. No one had ever before attempted to piece together these factors.

Elmore is also known for cover crop research to help increase soil quality and crop productivity over time. The challenge is incorporating cover crops sustainably into already well-functioning cropping systems. "Sustainability", of course, means efficient use of all inputs — including water. "Cropping systems need to be completely re-thought and modified to accommodate cover crops and reap their long-term benefits," he explained.

Sustainably improving productivity, Elmore points out, helps ensure a more water and food secure world. "DWFI provides critical support for all of this work," he said, "and provides linkages here at the university and around the world for more cooperation and interaction."

Following his recent retirement, Elmore's colleagues and students are carrying on his work. Additional cover crop research is expected to be published soon.

Mobile sensors use nuclear physics to get better soil moisture data

Farmers can optimize inputs if they understand how much water the soil can hold and how fast water and nutrients move through it. Trenton Franz with the University of Nebraska School of Natural Resources has been working on a number of innovative projects designed to improve water use efficiency and agricultural systems by providing better soil moisture data, including moisture variability across fields.

Trenton Franz

UNL School of Natural Resources Associate Professor & DWFI Charter Research Fellow

As a DWFI research fellow, Franz has worked successfully with scientists and farmers worldwide to combine applied nuclear physics with agriculture. One project is the impressive noncontact, passive cosmic-ray neutron probe that measures soil moisture in real time.

"The sensors can be used on ATVs, tractors and other vehicles, which greatly increases their usefulness for practical application in the future," he explained. Sensors also can be placed on autonomous vehicles to collect data sets useful across a broad scale.

All of Franz's work focuses on bridging the gap between applied science and practical application. "The research shows that the sensors work, but we need to make them economical, practical and scalable to make a difference," he explained. "A small gain in efficiency has huge benefits for farmers, as well as society, and this will be critical for water sustainability in the future."

The key to making the sensors practical, according to Franz, is to incorporate them into farm operations such as spraying, planting and harvesting.

Ultimately, data from ground-based geophysical sensors can be combined with data from satellite and UAV sensors that can't easily evaluate soil in the plant root zone. Franz said, "Combining these different data sources will be challenging but the work holds great promise."

Remote sensing, cosmic ray probes, automation are irrigation's future

When you hear Derek Heeren is an irrigation engineer, you probably don't think of satellites and unmanned aircraft and cosmic rays. But that's exactly where the future of variable rate irrigation (VRI) management lies – and exactly what Heeren has been developing with help from DWFI.

Derek Heeren

UNL Associate Professor & DWFI Charter Research Fellow

With his own research and in collaboration with other DWFI fellows and colleagues around the world, Heeren has developed sensors and software to help farmers precisely apply different amounts of water to different areas of fields.

As in many other agricultural research areas, technology and data are only good if they can be marketed and used daily. So, Heeren is collaborating with commercial irrigation companies to make VRI software practical for farmers at all production levels. The goal is to overlap data from multiple sources to provide more clarity and confidence in the products.

"The ultimate goal is to get closer to a process of automated irrigation with input from sensors, which saves farmers time and allows them to produce more food with less water," Heeren explained. He estimated practical adoption would take place within 5 to 10 years.

In the meantime, as with all DWFI research fellows, Heeren focuses on educating the next generation of specialists, from undergraduate students who go on to work as producers or industry consultants to graduate students who become leaders in industry or academia.

One of his next goals is to create more online irrigation courses for students who can't travel to Nebraska. "The fundamentals are as important as the cutting edge," Heeren said. "If the goal is impact, we need both."

From Argentina to America: digging into global yield gap

When Patricio Grassini came to the U.S. from Argentina to pursue his PhD at the University of Nebraska, the move in many ways wasn't easy. Like other international faculty, he had to adapt to a new place, language and people. But he says he found his way with the guidance and encouragement of his new colleagues.

Patricio Grassini

UNL Associate Professor, Cropping Systems Agronomist & DWFI Charter Research Fellow

Grassini earned his PhD in 2010 and has since become someone who now guides and encourages others as a UNL associate professor, original DWFI research fellow and internationally known expert on agricultural yield gap.

A review of Grassini's publications in the university's Digital Commons reflects the trajectory of his career, as well as development of humanity's understanding of water and food efficiency. His first listed publication in 2010 covered yield potential and resource use efficiency of maize systems in the Western U.S. corn belt. His latest publication digs deep into assessment of approaches for stratifying producer fields based on complex biophysical attributes for yield gap analysis.

Through his research, Grassini has played a role in improving agricultural productivity, water use and environmental protection from Brazil to sub-Saharan Africa to China, many times using Nebraska as a test laboratory. The capstone of his contributions is the Global Yield Gap Atlas, an online depository of agricultural data that has become a useful tool for farmers, policymakers and researchers worldwide.

Grassini is grateful to Nebraska for welcoming him and to DWFI for support. He said, "It was really the trust from DWFI that helped us kick the atlas off. Without the initial support, the atlas would not be there."

Data analysis as a foundation for water/food/energy research

What good is data if you can't understand how it impacts the world? Since 2014, with DWFI's support, Francisco Munoz-Arriola has worked to use data in new ways to understand surface water and groundwater systems. His work is helping to create water for food management paradigms that can lead to greater productivity and efficiency within the nuanced water/food/energy nexus.

Francisco Munoz-Arriola

UNL Associate Professor of Hydroinformatics and Integrated Hydrology & DWFI Charter Research Fellow

Munoz-Arriola's work is critical not only to help researchers and producers better understand data in general but also more specifically as a programmatic foundation that can enhance any water for food project that relies on data. His team has created and implemented models that assess both natural and built environments to make diagnostic systems more sustainable and secure. In other words, better data makes for more reliable water for food technologies.

"The most interesting part of this research," said Munoz-Arriola, "is the possibility of simplifying the complexity of the environment."

In addition to his numerous publications and projects, Muñoz-Arriola is a sought-after professor and advisor for graduate students. He has advised multiple doctoral students and serves as a faculty mentor for the WARI and Cultivate Access programs, helping to cultivate the next generation of water experts.

In recent years, artificial intelligence (AI) has added an amazing new layer to this work. Munoz-Arriola and his team used AI to propose new ways of improving groundwater forecasts around the world. This includes developing methods of identifying and reducing uncertain predictions of water availability, as well as predicting resilience in groundwater systems. Projects completed by Munoz-Arriola in the last decade allow agricultural decision makers to more easily upload, transform, store and analyze data to improve decision making and predictions.

Munoz-Arriola is particularly excited about the potential of using AI to predict shifts in groundwater and surface water systems as they respond to climate change – a completely new challenge for his next decade of research.

Crop water modeling helps farmers improve efficiency

In a perfect world, farmers would know exactly how much water and fertilizer to use to maximize yield and minimize environmental damage. We'll likely never reach that kind of perfection, but DWFI researcher Haishun Yang has created systems that bring farmers about as close as they can get.

Haishun Yang

UNL Associate Professor & DWFI Charter Research Fellow

Yang is known internationally for developing first-of-concept online crop simulation models and model-based crop management decision support tools. His research covers crop growth and yield, crop nitrogen rate management, real-time irrigation scheduling and assessment yield. "Farmers in some of the world's most water and food compromised regions now use these tools to improve results," he explained.

The tools Yang has been instrumental in developing include the Global Yield Gap Atlas and online modeling systems, Hybrid-Maize, Maize-N and CornSoyWater. According to Yang, younger farmers have used the models to make decisions that normally require years of experience. The systems also help decision-makers and policymakers improve policies by better predicting outcomes in varied scenarios.

"The science is sound, but the programs offer very user-friendly interfaces," Yang said. The popular models have appeared in more than 60 independent studies in peer reviewed publications. Industries in the U.S. and around the world license them and extension education programs use them for training and service.

What's next for Yang? He is working to integrate the tools into a comprehensive corn-soybean cropping system that will streamline producers' decision-making abilities through an entire growing season. The system also will aid extension, teaching and research. As the world's population grows, efficiency-producing tools like these will be critical to next-gen water and food security.

Strategic Partnerships

Alliance for a Green Revolution in Africa (AGRA)

Association of Farmers and Irrigators of the State of Bahia, Brazil (AIBA)

Environmental Defense Fund (EDF)

Food and Agriculture Organization of the United Nations (FAO)

Global Harvest Initiative

Groundwater Foundation

Global Water Partnership

Indian Agricultural Research Institute

Institute of Agriculture and Natural Resources (IANR)

International Food Policy Research Institute (IFPRI)

IHE Delft

IN2 Wells Fargo

International Commission on Irrigation and Drainage (ICID)

International Fund for Agricultural Development (IFAD)

International Water Management Institute (IWMI)

Irrigation Innovation Consortium

Lindsay Corp.

National Drought Mitigation Center (NDMC)

The Nature Conservancy

United States Agency for International Development (USAID)

U.S. Water Partnership

The World Bank

Federal University of Vicosa, Minas Gerais, Brazil

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World Water Council

World Wildlife Fund

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EA Engineering

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Heidelberg University

Nebraska Department of Environment and Energy (formerly NDEQ)

Nebraska Department of Natural Resources

Nebraska Environmental Trust

Nebraska Game & Parks Commission

Pennsylvania State University

Several Nebraska Natural Resources Districts (NRDs)

U.S. Department of Agriculture-ARS

U.S. Department of Agriculture-NIFA

U.S. Department of Agriculture-NRCS

U.S. Department of Agriculture-OCE

U.S. Department of Interior-GS

Credits

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Acronyms

ACRONYM	ORGANIZATION/TERM
AfDB	African Development Bank
AGRA	Alliance for a Green Revolution in Africa
AGRF	African Green Revolution Forum
ALEXI	Atmosphere-Land Exchange Inverse
BGMA	Bazile Groundwater Management Area
CASNR	College of Agricultural Sciences and Natural Resources at the University of Nebraska–Lincoln
CDI	Composite Drought Index
CUSP	CASNR Undergraduate Scholarship Program
DGs	Distillers' Grains
DWFI	Daugherty Water for Food Global Institute at the University of Nebraska
EDF	Environmental Defense Fund
EPA	Environmental Protection Agency
ET	Evapotranspiration
FAL	Future Agriculture Leaders
FAO	Food and Agriculture Organization of the United Nations
FCC	Federal Communications Commission
FY	Fiscal Year
GHG	Greenhouse Gas
GloDET	Global Daily Evapotranspiration
HA	Hectare
IANR	Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln
IAP	International Advisory Panel
IARI	Indian Agricultural Research Institute
ICBA	International Center for Biosaline Agriculture
IFPRI	International Food Policy Research Institute
IHE Delft	Institute for Water Education, Delft, The Netherlands
IIC	Irrigation Innovation Consortium
IUSSTF	Indo-U.S. Science and Technology Forum
IWMI	International Water Management Institute
MENA	Middle East and North Africa
MOU	Memorandum of Understanding
NASA	National Aeronautics and Space Administration
NDEE	Nebraska Department of Environment and Energy