Nebraska Water Center

Annual Report

2015

Water *for* Food
ROBERT B. DAUGHERTY INSTITUTE
NEBRASKA WATER CENTER
at the University of Nebraska

Omaha skyline

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Foreword

Nebraska Innovation Campus

The University of Nebraska has long been a national leader in water resources research and management and the NWC remains one of the key assets of the university. The university has significant expertise in a range of disciplines related to water and a strong track record of research in the subject. In particular, the university has faculty experts in water sciences, agricultural sciences, information sciences, social sciences, law and public health and administration as well as specialized centers on issues of great relevance to water resources management, such as the National Drought Mitigation Center. Furthermore, Nebraska's farmers, practitioners and policymakers are recognized as innovators in water technology and water institutions, as exemplified by the 1972 decision to establish Natural Resources Districts, a system of watershed-based governance entities led by locally-elected boards of directors that provides an effective institutional framework for managing the state's groundwater resources.

In keeping with the original intent to locate Water Resources Research Institutes state at each state's land-grant university, the NWC has since inception been located at the University of Nebraska-Lincoln, and specifically within the Institute of Agriculture and Natural Resources. With the development of the Robert B. Daugherty WFI, university leaders maximized the potential for synergy by bringing the NWC under the umbrella of the institute in 2012, while retaining its base within UNL. While the WFI focuses on water and food security, bridging Nebraska's vast resources with the rest of the world, the Nebraska Water Center and Water Sciences Lab fulfill their mission and Congressional mandate to address water quality and quantity issues of priority to the state of Nebraska.

We are proud of the Water Center's more than 50 years of leadership, research and development. NWC coordinates a wide range of research impacting water issues, facilitating a deeper understanding of water and its many beneficial uses; helps develop new water researchers; trains future water researchers and engineers; and disseminates water research results to water professionals and the public through publications, research colloquiums and conferences, electronic media, lectures and tours. The NWC provides state-of-the-art analytical technology for conducting research in water resources conservation for food production systems; serving as a technical resource to federal, state, and local officials on measurement methods and potential impacts to water quality and human health from the use of water resources for food production; and providing hands-on training of water scientists and engineers to help make informed decisions and shape policies impacting water resource quantity and quality.

Ronnie Green
Harlan Vice Chancellor of the Institute of Agriculture and Natural Resources
Interim Senior Vice Chancellor for Academic Affairs, University of Nebraska-Lincoln
Vice President for Agriculture and Natural Resources at the University of Nebraska

Roberto Lenton
Founding Executive Director
Robert B. Daugherty Water for Food Institute at the University of Nebraska

The Nebraska Water Center: Leadership in Research, Education and Communication

The Nebraska Water Center (NWC), an integral part of the Robert B. Daugherty Water for Food Institute (WFI) at the University of Nebraska, supports innovative water research and provides education and extension programming. With the Water Sciences Lab, it offers the technical and research expertise that supports Nebraska's reputation as an international leader in water resource research and management.

While a part of WFI, the NWC retains its base in the University of Nebraska-Lincoln (UNL) and the Institute of Agriculture and Natural Resources (IANR).

NWC coordinates a wide range of research impacting water issues, facilitating a deeper understanding of water and its many beneficial uses; helps develop and educate future water researchers and engineers; and, disseminates water research results to water managers, policy makers and the public through effective communications. Examples of these activities include:

- Sharing the latest research data with water managers and the public through conferences and workshops, printed materials, its website and social media platforms, interactions with news media and one-on-one contact with stakeholders.

- Connecting faculty with external collaborators and stakeholders, fostering interdisciplinary teams, alerting faculty to research funding opportunities and providing grants.

- Aiding new scientists through mentoring programs, seed grants and helping them build their research programs.

- Training future water managers, water and environmental professionals and agricultural producers through workshops, conferences and tours, as well as supporting student recruitment and developing academic programs to meet the needs and challenges of the future.

WFI and NWC: Working Together to Advance and Improve Water Resources in Nebraska

Both NWC and WFI seek to ensure that their work in Nebraska benefits from WFI's global reach, taking specific steps to connect work in Nebraska with WFI's global work. Where relevant, WFI shares the results and outcomes of its overseas research and policy work with stakeholders in Nebraska, and helps to make Nebraska's water research, innovations and governance expertise becomes known in other countries.

While the WFI focuses on subject areas that relate to the use of water in agriculture, NWC focuses on a broader set of water issues of priority importance to Nebraska, as defined by the university's Water Resources Advisory Panel (WRAP) and other stakeholders. These issues include water use for food production, and encompass water quantity, water quality, and basin-specific issues. Key topical areas include impacts of climate and weather on water resources; understanding and protecting water quality; groundwater-surface water interactions; improving water efficiency in crop production; drinking water and wastewater quality and management; ecosystems, ecology and adaptive management; economic impacts of water management decisions; and human dimensions of water use.

Sunrise over a Nebraska wheat field

Subject Areas of Focus / Geographic Scope	Both WFI Subject Areas of Focus and NWC Water for Food-related Topics	WFI Subject Areas of Focus	NWC Water Topics (Non-food-related)
Nebraska			
Global			

Interface between WFI and NWC activities: The green cell depicts the areas in which both WFI and NWC are active. The yellow cell depicts where WFI is exclusively active and the blue cell depicts the areas where NWC is exclusively active.

Importantly, all activities depicted in green are co-branded as WFI/NWC activities, regardless of whether WFI or NWC takes the lead.

Director’s Letter

NWC director Chittaranjan Ray addresses a retreat at UNK

I am pleased to present this 2015 annual report on behalf of the Nebraska Water Center and Nebraska Water Sciences Laboratory.

In Nebraska, water is the most vital component for us all. We are fortunate to be blessed with rich supplies of groundwater beneath our feet. This groundwater helps fuel a growing agricultural economy and provides approximately 85 percent of the water we use for human consumption. As the top state in the country for crops under irrigation, agriculture is our leading consumer of water by far, but water is also an essential component for generating electrical power, supporting manufacturing, tourism and recreation, and for growing cities and towns.

These many demands on our water resources create complex challenges to ensuring we have access to the water we need, well into the future. The Nebraska Water Center is a trusted and valued leader in this arena, helping to bring people and resources together to solve Nebraska's water issues.

We do this by sticking to the core mission that has guided the Nebraska Water Center for the past 51 years and which will carry it into the future: ensuring water sustainability by coordinating research, training and educational water-related activities; helping train the next generation of water scientists, conducting seminars, symposiums and retreats, promoting interdisciplinary education programs, and promoting graduate education in water resources.

An important tool in accomplishing this for the past 25 years has been the Nebraska Water Sciences Laboratory. The lab is a cutting edge analytical facility, dedicated to assisting the academic community with its research, as well as with developing new methodologies and training future scientists. We dedicate this annual report to the lab on its Silver Anniversary.

We are pleased to be an integral part of the Robert B. Daugherty Water for Food Institute as it continues to help solve one of the 21st Century's most urgent challenges: Global food security with reduced pressure on water resources.

Thank you for reviewing the work accomplished by the Nebraska Water Center and Nebraska Water Sciences Laboratory this past year. We look forward to continuing our mission and service to Nebraska for many years ahead.

Chittaranjan Ray, Ph.D., P.E.
Director
Nebraska Water Center
University of Nebraska

For More Than 50 years: The Nebraska Water Center

The NWC was established by Congressional mandate as one of 54 Water Resources Research Institutes in 1964. Its research and programs support and promote the University of Nebraska as an international leader in water research, teaching, extension and outreach.

After more than 50 years, the NWC's role is more important than at any time in its history.

Annual water symposium, University of Nebraska College of Law

Helping Build the Future

The NWC helps mentor graduate students, post-doctoral researchers and new faculty members to help them establish successful careers.

New faculty are invited to attend several brown bag sessions during the year to help them connect with and get advice from senior faculty and external partners on topics such as working with stakeholders, multidisciplinary research and managing large data sets over the course of their careers.

In addition to helping link individual faculty members to groups, NWC faculty and staff meet with faculty members individually upon their arrival and as needed afterward.

The NWC also has a long-standing assistantship program for graduate students that allows them to work on applied water resource analysis or research through the Nebraska Department of Natural Resources.

This partnership supports one graduate student for up to two years, potentially providing the intellectual content for a thesis or dissertation. Study and work can be in many areas, including hydraulic and hydrologic relationships between surface and groundwater, streamflow analysis, water supply and demand, land use data, precipitation and climate data, technical tools for economic analysis of water options, among others.

Sandhill Cranes over the Platte River

Nebraska Water Center Advisory Board

The advisory board advises and strengthens the Nebraska Water Center as it carries out its mission of supporting water-related research, education and outreach, and sharing information with constituent groups.

The advisory board offers guidance in several areas, such as research needs in Nebraska; events and programs for facilitating interdisciplinary research; academic programs; seed grant awards; and topics for outreach events.

Current members are:

John Bender
Nebraska Department of Environmental Quality

Jesse Bradley
Nebraska Department of Natural Resources

Dana Divine
UNL School of Natural Resources and Conservation and Survey Division

Bruce Dvorak
UNL Department of Civil Engineering

Dean Eisenhauer
UNL Department of Biological Systems Engineering and NU's Robert B. Daugherty Water for Food Institute

Tom Franti
UNL Department of Biological Systems Engineering

Richard Holland
Nebraska Game and Parks Commission

Shannon Bartelt-Hunt
UNL Department of Civil Engineering

Alan Kolok
UNO Nebraska Watershed Network

Roberto Lenton
Robert B. Daugherty Water for Food Institute

Dan Miller
U.S. Department of Agriculture/ARS

John Miyoshi
Lower Platte North NRD

Chittaranjan Ray
Nebraska Water Center and UNL Department of Civil Engineering

Tim Shaver
UNL Department of Agronomy and Horticulture and West Center Research and Extension Center

Steve Thomas
UNL School of Natural Resources

Karrie Weber
UNL School of Biological Sciences and Earth and Atmospheric Sciences

Ron Zelt
USGS Nebraska Water Science Center

Water Resources Advisory Panel: A key to success

In recognizing the importance of water to the environmental and economic well-being of the state, the University of Nebraska has had a commitment to excellence in water resources research, education and outreach for decades.

Ten years ago, Nebraska was facing serious water issues as a result of interstate compacts and agreements, state statutes, continuing drought and other factors. To help address these concerns, the Nebraska Water Center developed the Water Resources Advisory Panel (WRAP) to better connect NU with the wisdom of outside experts and those who often rely on NU water-related research, education and outreach to make decisions impacting Nebraska's water resources.

Fifteen individuals, representing a cross section of the Nebraska water community serve on WRAP, providing guidance to the university on state water research needs, education and outreach programs. WRAP is convened by Ronnie Green, Harlan Vice Chancellor of the Institute of Agriculture and Natural Resources; Interim Senior Vice Chancellor for Academic Affairs, University of Nebraska-Lincoln; and Vice President for Agriculture and Natural Resources at the University of Nebraska; and Prem Paul, Vice Chancellor for UNL's Office of Research and Economic Development. The group generally meets in January, April and September..

Current Members:

Frank Albrecht, Nebraska Game and Parks Commission; Brian Barels, Nebraska Public Power District; Mark Brohman, Nebraska Environmental Trust; Jerry Johnson, state senator and Agriculture Committee chair, Nebraska Legislature; Eugene Glock, Cedar Bell Farms; Jerry Kenny, Platte River Recovery and Implementation Program; Marian Langan, Audubon Nebraska; Joel Christenen, Metropolitan Utilities District; Lee Orton, Nebraska Well Drillers Association; Jay Rempe, Nebraska Farm Bureau Federation; Jim Macy, Nebraska Department of Environmental Quality; Ken Schilz, state senator, Natural Resources Committee chair, Nebraska Legislature; Gordon "Jeff" Fassett, Nebraska Department of Natural Resources; Pat O'Brien, Upper Niobrara White Natural Resources District; Dayle Williamson, retired U.S. senate staff.

Others Who Work Closely with WRAP Include:

Others who work closely with WRAP include, Ron Yoder, associate vice chancellor, UNL IANR; Monica Norby, assistant vice chancellor, UNL Office of Research and Economic Development; Chittaranjan Ray, NWC director; and Derrel Martin, UNL Extension and UNL Department of Biological Systems Engineering.

Rachael Herpel, assistant director of the Water for Food Institute, serves as the liaison and coordinator for panel activities and for water faculty activities associated with WRAP.

Information for Our Clients and the Public

The NWC is produced with partial financial support from the U.S. Department of the Interior's U.S. Geological Survey. In particular, this funding helps underwrite:

- Publication of four quarterly issues of the Water Current newsletter, which is distributed free to more than 2,800 subscribers and is also available in PDF format at watercenter.unl.edu. The Water Current has been published since 1968, making it one of the longest running of such publications in the U.S. It features professional faculty and staff, guest columns, director's column, feature articles on research and educational programming, news of upcoming events and other information.

- Production and distribution of NWC fact sheets, information brochures and press releases reporting on water-related research and outreach programming with ties to NWC and the University of Nebraska.

- Two comprehensive websites:
  Nebraska Water Center: watercenter.unl.edu
  Water Sciences Laboratory: waterscience.unl.edu

- Publicity and supporting materials for the annual water symposium and water law conference, annual public lecture series, brown bag lectures and cooperative water and natural resources tour.

- Active engagement with stakeholders through Facebook and Twitter.

The NWC's communication coordinator plays an important role in helping to manage and produce UNL Extension exhibits for Penton Industries' Husker Harvest Days farm show located near Grand Island. The annual event is one of the largest commercial farm shows in the nation with more than 600 exhibitors and nearly 200,000 visitors. The event provides a great opportunity to showcase exhibits on UNL research and extension programming, and to assist UNL's Institute of Agriculture and Natural Resources Institute with student recruitment.

NWC works closely with state, local and national media by way of press releases and personal contact with reporters and writers. The releases support and cross many departmental and academic lines within the University of Nebraska system and NWC writes them for many faculty members who do not have communications or public relations support staff readily available to them.

Additionally, NWC publishes a broad range of brochures, pamphlets and fact sheets detailing its mission and programming, news, events and more.

IANR/UNL Extension activities at Husker Harvest Days near Grand Island

GeoProbe research team at Grand Island

Primary Goals:

The Nebraska Water Center's primary goal is to address water issues and challenges of priority importance to Nebraska and help position NU as a state and national leader in teaching, research and extension eduction in water sciences, water management and water law and policy, and to serve Nebraskans in these critical areas. Specifically, to:

- Develop, facilitate and implement research, teaching and outreach programs in water sciences.
- Expand the financial resource base for NU water programs from private, non-governmental and governmental sources.
- Establish and maintain collaborative linkages with state and federal agencies, industry, producers and other water resource entities.

Research Areas:

- Impacts of climate and weather on water resources.
- Understanding and protecting water quality.
- Groundwater-surface water interactions.
- Improving water efficiency in crop production.
- Drinking water and wastewater quality and management.
- Ecosystems, ecology and adaptive management.
- Economic impacts of water management decisions.
- Human dimensions of water use.

Examples of NWC Water Research:

- Using underground wireless sensor networks to measure soil moisture to reduce irrigation frequency.
- Developing a simple and inexpensive process to treat groundwater polluted with trichloroethelene (TCE), a common and toxic groundwater contaminant.
- Mitigating effects of and reduce use of pesticides, pharmaceuticals and livestock supplements to improve surface and groundwater quality.
- Investigating the degree of connection between the Platte River and nearby groundwater.
- Employing cutting-edge research methods in remote sensing to detect and monitor lake water quality, including toxic algal blooms.
- Investigating the occurrence, distribution, vulnerability and mitigation of small community water supplies related to groundwater uranium and arsenic.
- Improving water management through evapotranspiration quantification.
- Conducting irrigation efficiency studies such as subsurface-drip irrigation and decision-support tool usage.
- Providing regional leadership in global climate change research related to water.

New Water Management Arsenal:

Nebraska weather has one constant factor: change. Farmers rely on accurate weather forecasting and agricultural technology, such as center pivot irrigation, to help them mitigate weather variability and increase yields. The University of Nebraska-Lincoln is giving them a new tool for their irrigation management arsenal – one with the potential to decrease costs, conserve water and improve yields. Mehmet Can Vuran, UNL computer scientist and electrical engineer, developed wireless underground sensor networks to give agricultural producers real-time information about soil moisture and changing conditions that will allow them to more efficiently manage irrigation.

Making Every Drop Count:

In Nebraska, as well as around the world, farmers are challenged to conserve water and use it more efficiently, while still meeting crop water requirements to maintain high yields. The Nebraska Agricultural Water Management Network was launched in 2005 as a cooperative effort by UNL Extension, the Upper Big Blue Natural Resources District, growers in south central Nebraska and, the Natural Resources Conservation Service. It has grown to a network of more than 800 producers throughout Nebraska, all using cutting-edge technology to determine when and how much to irrigate in order to make every drop count.

Mobilization of Groundwater Uranium:

UNL researchers are studying what effect groundwater nitrate contamination may have on stimulating the movement of naturally occurring uranium deposits. Karrie Weber, a biogeochemist in UNL's School of Biological Sciences and Department of Earth and Atmospheric Sciences; Daniel Snow, hydrogeochemist and director of the NWC's Nebraska Water Sciences Laboratory; and Kate Campbell, biogeochemist for USGS based in Boulder, Colorado, will team on the project, which was awarded a nearly $231,000 grant from the USGS. Non-federal matching funds will bring the three-year project total to $467,500. Over time, the researchers hope to better understand how groundwater nitrate contamination may influence the mobility of naturally occurring uranium in aquifers that provide public and private drinking water supplies throughout the U.S.

USGS 104b Projects

The Nebraska Water Center awarded annual U.S. Geological Survey (USGS) 104b project funds to four University of Nebraska-Lincoln research teams in November 2014 for fiscal year 2015.

Funded projects were required to pass a rigorous review by a panel of academic and professional colleagues. These four projects were selected for funding from March 1, 2015, through Feb. 28, 2016:

Design of Multi-Scale Soil Moisture Monitoring Networks in Agricultural Systems Using Hydrogeophysics, PI: Trenton Franz, UNL School of Natural Resources, $20,000.

Climate Variability and Decision Support Tool for Optimizing Yields with Limited Water Available for Irrigation, PI: Jane Okalebo, UNL School of Natural Resources, Co-PI: Kenneth Hubbard, UNL School of Natural Resources, $16,500.

Fate of Manure-Borne Antimicrobials Monensin, Lincomycin, and Sulfamethazine and Potential Effects to Nitrogen Transformation in Soil, PI: Daniel Snow, Nebraska Water Center, Robert B. Daugherty Water for Food Institute at the University of Nebraska (Nebraska Water Sciences Laboratory), Co-PI: Matteo D'Alessio, Nebraska Water Center/Nebraska Water Sciences Laboratory, $20,000.

Development of Smart Alginate Hybrid Beads for Eco-Friendly Water Treatment, PI: Jaehong Shim, Visiting Scientist/Postdoctoral Assoc., UNL School of Natural Resources, Co-PI: Patrick Shea, UNL School of Natural Resources, $15,000.

USGS program funds for these projects are issued under provisions of the federal Water Resources Research Act of 1984.

Dvorak, Ray Aim at Improving Water Quality for Small Communities

Decades of innovation have helped large American cities improve their public water systems, but smaller, rural systems are being left behind.

To address rural water development the U.S. Environmental Protection Agency provided a three year, $4.1 million grant to develop the Water Innovation Network for Sustainable Small Systems (WINSSS), a national project that hopes to bring updated technology and safer water to small communities.

WINSSS, is headquartered at the University of Massachusetts-Amherst, with associate centers at UNL and the University of Texas at Austin.

At UNL, environmental engineer Dvorak directs WINSSS operations, working alongside Chittaranjan Ray, director of the NWC and Rebecca Lai, UNL professor of chemistry. Dvorak is a former interim director of the Nebraska Water Center.

The project has particular relevance in Nebraska, where most public water systems serve fewer than 10,000 people and normally have less funding and small operations staffs. Many small systems, Dvorak said, also have public health violation rates three times that of larger cities.

“A large system, like Denver or Omaha, can hire consultants and researchers and develop new technologies,” he said. “Small communities don’t have that. And in Nebraska, given that not a lot of smaller communities are growing, there’s not a lot of financial capacity. We’re trying to develop markets and modify existing technologies to make them appropriate for small systems.”

However, improving and updating small public water systems is not a simple task.

EPA had not previously put a lot of funding or research into updating these systems, Dvorak said.

“Many of the technologies work for Lincoln or Grand Island but are not well-adapted for a small community. The assumption has been that what works for big communities is the priority, and that small communities should figure out how to do this. It hasn’t been real effective,” he said.

“EPA wants researchers to start taking technologies – like off-the-shelf sensors and point-of-use devices – and adapt them for the unique situations of small water systems, so that entrepreneurs can start making them available for the actual systems,” he added.

WINSSS is providing research and testing information to multiple state regulatory agencies with the hope that when one state approves the new product, others will follow suit.

“Legislators and congressional delegations are concerned about finding cost-effective solutions for supplying safe drinking water for these small communities,” Dvorak said. “What we’re trying to do is reduce the risk.”

“We’re being given funding for three years’ work, but I see this lasting at least 10 years,” he said. “We’re trying to not just have scientists and engineers develop innovation, but set up a framework where we can go back and forth with government agencies and communities to figure out what makes sense now and for the future.”

Irrigated wheat in southwest Nebraska

Special seminars are presented throughout the year

October Retreat at UNK

University of Nebraska faculty joined current and potential partners for a retreat at the University of Nebraska at Kearney (UNK) on Oct. 7, providing an opportunity for faculty and students to showcase their research and for partners to ask questions and discuss areas where further partnership may be beneficial.

Many of the participants traveled from Lincoln's Nebraska Innovation Campus to UNK's Ockinga Seminar Center on a tour bus for the full day of presentations and discussions.

Faculty from UNK and UNL gave four-minute presentations on current research projects and future collaborative interests.

After lunch and poster viewing, federal, state, regional and local partners delivered short presentations on potential opportunities for collaboration with NU faculty.

Some of the agencies represented in these presentations included the U.S. Department of Agriculture's Natural Resources Conservation Service, U.S. Army Corps of Engineers, U.S. Geological Survey, Nebraska Department of Natural Resources, Nebraska Environmental Trust, Nebraska Department of Agriculture and the Nebraska Water Balance Alliance.

Many of the state's 23 Natural Resources Districts were also represented, as was The Nature Conservancy, Platte River Recovery Implementation Program, the Central Nebraska Public Power and Irrigation District, Field to Market and the Lower Platte River Corridor Alliance.

Public Water Lectures

The University of Nebraska's spring semester water seminars included seven free public lectures on current water issues and research.

The lectures were held roughly every-other-week beginning Jan. 14 and running through April 22. All lectures were located in Hardin Hall on the University of Nebraska-Lincoln's (UNL) East Campus.

"Each year we assemble a broad base of informative and educational talks on current state and regional water issues and current research that we hope are appealing to both students and the public," said Chittaranjan Ray, director of the Nebraska Water Center, which has helped organize and offer the annual water lectures since the 1970s.

Jasper Fanning, general manager of the Upper Republican Natural Resources District in Imperial, opened the series with a talk on the Nebraska Cooperative Republican Platte Enhancement (N-CORPE) pipeline designed to pipe groundwater into the Republican and Platte Rivers when needed to meet river flow requirements.

Other talks focused on UNL's groundwater monitoring program, uranium contamination in municipal water systems, high-resolution GIS monitoring of the water cycle, the value of groundwater, wellhead protection programs and groundwater models for decision-making.

On Jan. 21, an off-week for the normal lecture series, Chuck Schroeder, executive director of the Rural Futures Institute at the University of Nebraska, shared the mission and vision of the institute.

The lectures were co-sponsored by the NWC and UNL's School of Natural Resources, which offers the lecture series for student credit.

The complete lecture schedule was as follows:

Jan. 14 - Jasper Fanning, Upper Republican NRD, "N-CORPE pipeline project."

Jan. 28 - Aaron Young, UNL School of Natural Resources, "Groundwater monitoring program."

Feb. 11 - Lynn Mayhew, Grand Island Utilities Department, "Uranium contamination in municipal water supplies."

Feb. 25 - Paul Houser, George Mason University, "A vision for an ultra-high resolution integrated water cycle observation and prediction system."

March 11 - Kremer Lecture: Michael Schneiders, Water Systems Engineering, Inc., "The value of groundwater."

April 8 - Ryan Chapman, Nebraska Department of Environmental Quality, "Wellhead protection."

April 22 - Williams Lecture: T. Prabhakar Clement, Dept. of Civil Engineering, Auburn University, "Worthiness of complex groundwater models for decisionmaking – when should we say enough is enough?"

2015 Special Seminars

The Nebraska Water Center sponsored or co-sponsored several special seminars over the past year:

- Sept. 24: Dennis C. Flanagan, U.S. Department of Agriculture-Agricultural Research Service, USDA Process-based Tool for Estimating Runoff, Soil Loss and Sediment Yield – The WEPP Model.

- Sept. 30: Hatim M. E. Geli, Department of Civil and Environmental Engineering, Utah State University, Remote Sensing for Water Resources Management: Needs and Challenges.

- Oct.28: Kent Zimmerman, Nebraska Natural Resources Commission Resources Development and Watershed Funds, NRC Watershed Funds Webinar.

- Nov. 3: Matthew Reed, Layne's Ranney Collector Well Group, City of Lincoln Water Supply Expansion Using Ranney Collector Wells.

Speakers at the Nebraska Water Symposium

2015 Water Symposium and Water

The NWC's Water Symposium and Water Law Conference were held back-to-back at the University of Nebraska's College of Law March 19 and 20.

"On the first day, we focused on research, practices and policy related to sustainability of the High Plains aquifer for food production and water supply. The next day concentrated on Nebraska water law for practicing attorneys and other water law professionals," said NWC Director Chittaranjan Ray.

Co-sponsors included NU's College of Law, the U.S. Geological Survey Nebraska Water Science Center, Robert B. Daugherty Water for Food Institute and the Natural Resources Section of the Nebraska State Bar Association.

Speakers on March 19 focused on sustainability and use of the High Plains aquifer which underlies approximately 174,000 square miles in portions of South Dakota, Nebraska, Wyoming, Colorado, Kansas, Oklahoma, New Mexico and Texas.

Jim Butler of the Kansas Geological Survey spoke about a first order approach to assess the aquifer's sustainability in western Kansas; the University of Nebraska-Lincoln's Jesse Korus followed with a presentation on the aquifer's geology and hydrology and Steve Peterson of the USGS Nebraska Water Science Center talked about modeling water flow in the northern portion of the aquifer.

Law Conference

District Court Judge James E. Doyle IV

Other speakers included producers Roric Paulmann of the Nebraska Water Balance Alliance and Glenn Schur of the Texas Alliance for Water Conservation, and researcher Anthony Kendal of Michigan State University.

Local studies of the aquifer were presented by Steve Sibray, UNL Conservation and Survey Division; Lyndon Vogt, Central Platte Natural Resources District; Nick Brozovic, WFI; and Nathan Schaepe, USGS Nebraska Water Science Center.

A panel discussion on future use and sustainability of the High Plains Aquifer concluded the day.

The conference the next day covered the latest in regulatory and statutory changes in Nebraska water law, particularly new developments directly impacting local and regional water law.

Discussions included federal impacts on water law, such as water quality efforts under the Clean Water Act in Florida, the Chesapeake Bay region and in the Mississippi River watershed that could impact Nebraska.

Assistant to the Solicitor General at the U.S. Department of Justice Ann O'Connell provided the keynote address.

Jasper Fanning of the Upper Republican Natural Resources District (NRD) and Jim Schneider of the Nebraska Department of Natural Resources discussed innovations and developments in integrated management. There was also a panel discussion on NRD administration related to handling claims and disputes.

The Honorable James E Doyle IV, Judge of the District Court, 11th Judicial District, Nebraska closed the conference with a session on ethics in the water law arena. NU's College of Law and the Natural Resources Section of the Nebraska State Bar Association co-sponsored the day's event.

Continuing legal education credits were made available for Nebraska, Iowa and Colorado.

Water Tour Visits Republican River Basin in Nebraska and Colorado

June water tour to the Republican River basin

The annual Water and Natural Resources Tour took participants on a guided exploration of surface and groundwater irrigation and compact litigation issues in the Republican River watershed in Nebraska and Colorado June 23-25.

The tour began and ended in Holdrege and traveled as far west as Burlington, Colorado with many stops in between. Tour organizers felt the time was right to thoroughly re-examine basin issues affecting water users, producers, communities and economies in the three states that share its waters. The tour last visited the basin seven years earlier.

Kearney Hub reporter Lori Potter wrote a series of newspaper articles chronicling the tour's primary stops, issues and discussion topics, serving as a virtual tour of the trip. The articles can be read online at: http://bit.ly/1RP18Dv

Tour co-sponsors were The Central Nebraska Public Power and Irrigation District, UNL's Institute of Agriculture and Natural Resources, the Lower, Middle and Upper Republican and Tri-Basin Natural Resources Districts, Nebraska Rural Radio Association, NU's Robert B. Daugherty Water for Food Institute and the Nebraska Water Center. Nearly 70 people of varied backgrounds and interests were on tour, including UNL undergraduate, graduate and exchange students and several students in the Nebraska State Irrigation Association's current Water Leaders Academy class.






Tour Explores Republican River Basin

Jasmine Mausbach, Water for Food Institute student intern

This summer's Water and Natural Resources Tour included nearly 70 participants, from college students to retired farmers, and most with a firm background in water quality and quantity issues – except for me. As a 19-year-old undergrad student at the University of Nebraska-Lincoln (UNL), I set out with a vague awareness of the water issues facing Nebraska and neighboring state irrigators, but nothing to the extent that was presented on tour.

The focus of this particular tour, organized by the Nebraska Water Center, was the Republican River Basin. We traveled across Nebraska from Holdrege into the northeastern farmland of Colorado. I was given the opportunity to see the effects of groundwater depletion first-hand and hear about tensions between surface and groundwater irrigators. I was also surrounded by a multitude of people who were well versed in groundwater, surface water, land subsidence, center pivot irrigation, resource management and more.

I learned the Republican River runs through three states: Nebraska, Colorado and Kansas. There is a nearly 75-year-old legal compact between these three states that mandates each of them to maintain a certain amount of streamflow in the Republican River across borders and to adhere to groundwater and surface water models. Each state must comply with these stipulations each year, which can be tough to do when the demands for irrigation water for crops is high and the amount of water in the river is low, as happens during drought years. This is just one of the issues the states deal with in this delicate balance, especially in eastern Colorado and western Nebraska where the climate is more arid.

I saw how some of these compact issues plague Colorado communities, specifically in the Bonny Reservoir area near Idalia. The compact requires Colorado to deliver a specified amount of streamflow, and due to evaporation and leakage from the reservoir, the state wasn't meeting its obligation. Additionally, the state was being charged for the evaporation and leakage, so a decision was made to drain the reservoir completely to reduce costs. Bonny Reservoir once flourished as a site for recreation, irrigation and flood control. Today, its gates stand open and the reservoir is largely gone, having become little more than waterfowl-inhabited wetlands most of the year.

Nebraska also has some longstanding issues balancing compact compliance and water use for irrigation. However, thanks to the recent Nebraska Cooperative Republican Platte Enhancement (N-CORPE) Project, Nebraska now has a system to meet compliance each year. To meet streamflow requirements downstream in Kansas, the project pumps groundwater into Medicine Creek, a tributary of the Republican River Basin. Some argue that the N-CORPE project solves a short-term problem while worsening the long-term problem of groundwater depletion.

Luckily, there have been great technological advances and programs developed in the last decade that increase the efficiency of water use not only in Nebraska, but also across the globe. UNL's Nebraska College of Technical

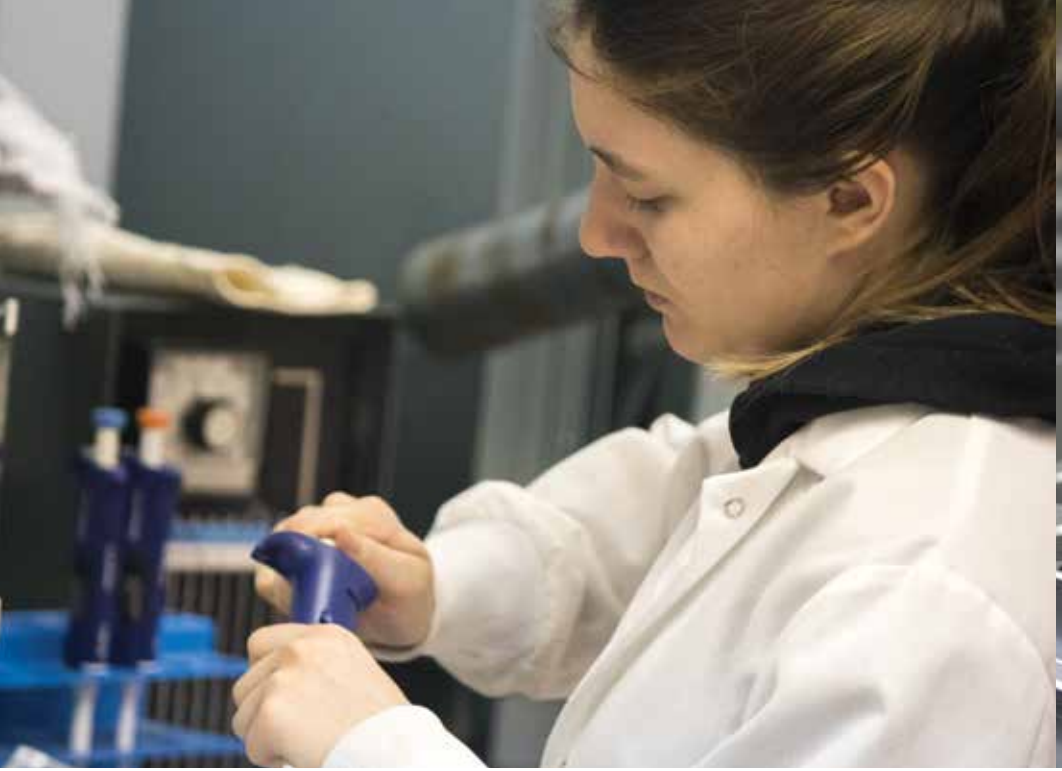
Agriculture in Curtis is an example of a program that teaches students farming techniques that use the least amount of resources for the highest yield. In McCook, we toured Valmont Industries, Inc., the largest center pivot producer in the world, seeing how they maximize water use through highly efficient center pivot irrigation systems. Near Republican City we learned how invasive species eradication projects also have benefited water levels across the state by removing non-native plants that consume large quantities of water resources.

After many eye-opening and fact-filled stops along the way, a boat excursion on The U.S. Army Corps of Engineer's Harlan County Reservoir was a great way to end the tour. Sitting back and enjoying some fresh air while cruising past the reservoir's ongoing dam repairs was a nice break from traveling in a charter bus. And at the end of the day, cruising on that pontoon, I realized surface water and groundwater issues are one and the same and that there is no silver bullet when it comes to finding a solution. However, states, irrigation districts, natural resources districts, farmers, irrigators, and even homeowners can make a difference if we work collectively toward water sustainability for the future. It will require a lot of discussion, policymaking and the will to manage our natural resources for future generations. I look forward to being part of that discussion, helping Nebraska and our world to sustainably use our limited and precious water resources.

The Nebraska Water Center co-organizes and hosts water and natural resource summer tours annually, both in and outside of Nebraska. Keep updated by following them at watercenter.unl.edu.

Student intern Jasmine Mausbach

Equipment at the Water Sciences Laboratory



Equipment and Expertise for Research and Teaching

The Nebraska Water Sciences Laboratory (WSL) was established as a core research facility at the University of Nebraska-Lincoln as part of the Nebraska Water Center in 1990. The facility was created to enhance and support NU water research as a state-of-the-art laboratory that could provide technical services and expertise in analytical and isotopic methods.

To this end, WSL provides specialized instrumentation and methods for organic contaminants, heavy metals and for stable isotope mass spectrometry. WSL's faculty, staff and students have analyzed thousands of samples at the facility over the past 25 years.

WSL currently houses about $2.5 million in analytical equipment and a staff that includes a director and four full-time technical staff:

- Daniel D. Snow, director of services (1990)
- David Cassada, separations chemist (1990)
- Aaron Shultis, isotope scientist (2006)
- Sathaporn Onanong, research technologist (2007)
- Autumn Longo, research technologist (2014)

The lab's major analytical equipment is used for a variety of purposes to support research and to help develop new scientific methodologies:

Water Sciences Laboratory at the University of Nebraska-Lincoln

Stable Isotope and Noble Gas Mass Spectrometry

- Thermo Helix SFT Noble Gas Mass Spectrometer
- Hidden Analytical Residual Gas Analyzer
- Cryogenic Gas Extraction System
- GV Isoprime Dual Inlet-Multiprep
- TraceGas pre-concentration system
- GV Isoprime – EA Continuous Flow
- GV2003 Continuous Flow Isoprep/Isocarb
- Micromass Optima Dual Inlet
- Offline high-vacuum prep systems
- GV Isoprime – EA Continuous Flow
- GV2003 Continuous Flow Isoprep/Isocarb
- Micromass Optima Dual Inlet
- Offline high-vacuum prep systems

Trace Element Analysis

- GV Platform XS Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
- SSI Liquid chromatography pump and autosampler for speciation methods
- CEM MARS Xpress Microwave Digester
- Cleanroom and acid handling lab

Environmental Analysis

- Agilent 5973 GC/MS
- Agilent 5972 GC/MS
- CombiPAL automated extraction system
- Agilent 6410 Triple Quadrupole LC/MS/MS
- Quattro Micro Triple Quadrapole LC/MS
- Spark Holland Symbiosis Environ on-line extraction system
- Waters 2695 HPLC with Photodiode array and Fluorescence detectors
- IN/US Radioactivity Detector (14C-labelled compounds)

Standard Water Quality Methods

- Seal AQ2 Discrete Chemistry Autoanalyzer
- Lachat QuikChem 8500 Autoanalyzer
- Dionex ICS-90 Ion Chromatography system
- OI Analytical Model 1010 TOC Analyzer
- Perkin Elmer Lamba 25 Spectrophotometer
- Perkin Elmer AAnalyst 400 Spectrophotometer

Twenty-Five Years on the Cutting Edge of University of Nebraska Research

At its purest form, water is two parts hydrogen to one part oxygen. But water craves other elements and particles, which also are deeply attracted to water. Sometimes these chemical marriages are benign or beneficial, other times they can be problematic, even detrimental.

For 25 years the Water Sciences Laboratory at the University of Nebraska-Lincoln has sussed out these chemical alliances, and in doing so established itself as one of the nation's premiere laboratories in answering the question of "what's in the water?"

The lab was founded in 1990 with funding from the Nebraska Research Initiative, which was established by the Nebraska Legislature to promote research in critical areas. Since then, it has become what the university calls a "core research facility" that does work with researchers and scientists in a number of disciplines across colleges and campuses.

The lab's scientists provide technical services and expertise in analyzing contaminants in water using high-tech instruments. That concept of "expertise" is the critical feature, said Chittaranjan Ray, who directs the University of Nebraska Water Center, of which the Water Sciences Laboratory is a key player.

While the instruments – mass spectrometers, gas or liquid chromatography and other analyzers – run the samples, it's the design of the experiments and the creation of the processes that develop the samples, and analysis of the findings that differentiate this lab from others, Ray said.

"The human brain is more important than the machinery," Ray said. "The real difficulty is coming up with the methods of separating the samples and compounds; it's the design of the experiment, each of which is unique. In academic research, there is a lot of trial and error. In our lab, the scientists are also training students in the methodologies. And it's a beautiful collaboration with faculty and students that also builds the university's research capacity and research portfolio."

"Of the 54 U.S. water centers, just 14 have water sciences labs," Ray said. "Nebraska's is one of the biggest and best because of the chemists, interns, students and number of collaborators across so many disciplines."

Lab director Dan Snow has been affiliated since the beginning in 1990, when he was a Ph.D. candidate in chemistry. Snow's research Snow contributed field and laboratory methods to the WSL's first big project, the Management Systems Evaluation Area (MSEA).

The MSEA analyzed thousands of groundwater samples from areas near Shelton to understand how different irrigation

Practices affected groundwater quality and contamination. Dozens of scientific papers emerged from the studies.

Many of these studies showed that water-conserving irrigation practices not only saved water, Snow said, but

they also improved groundwater quality without negatively affecting crop yields.

Subsequent studies suggest that water and fertilizer management practices could be contributing to high rates of naturally occurring uranium in ground water, Snow said. A current federally funded study with UNL scientist Karrie Weber is investigating the specific mechanisms connecting nitrate, irrigation and uranium mobilization.

These and other projects exemplified what Snow calls applied science — looking for ways to control or minimize negative impacts for future water users.

Twenty-five years ago, the lab was testing mostly for the herbicide atrazine and for nitrates. Since then, instruments have become more sensitive and can test for myriad other contaminants at far smaller concentrations. This is where the lab scientists' abilities to create methods that exploit the instruments' capabilities, become critical and evident.

Many of these studies are done at the request of Nebraska's Natural Resource Districts, who are charged with managing Nebraska's groundwater. "NRDs want to know where to best spend their resources," Snow said, "so knowing the source of problems helps to prioritize."

Snow, Ray and Cassada said the lab has contributed knowledge to the field of "emerging contaminants," which include algal toxins, explosives, petrochemicals, pharmaceuticals, estrogens, antibiotics and illegal drugs. The lab scientists also have developed protocols to analyze for contaminants in foods and food components.

Equipment at the Water Sciences Laboratory

Nebraska Water Sciences Laboratory 1990-2015

The Nebraska lab is testing for neonicotinoids, a type of insecticide chemically similar to nicotine with controversial environmental impacts.

While much of the lab's funding comes from Nebraska Research Initiative, Ray said long-range plans include developing a business model that encourages entrepreneurship and frees the lab's five scientists to collaborate with their university research colleagues.

"I'm very fortunate to have been able to work with faculty and students in so many disciplines during my career," Snow said "Natural resources, geosciences, life sciences, engineering, economics. I get to dabble in a lot more interesting things than if I were in just one department. It's enjoyable to meet and work with so many different viewpoints of water."

Summer Expedition to Kazakhstan

Big Almaty Lake in Kazakhstan

While its principal focus is on Nebraska, the WSL engages in selected international collaborations that provide opportunities to work in new and emerging areas as well as contribute to WFI's global agenda, particularly in the area of ecosystems and public health. As part of this approach, eight U.S. scientists teamed with students from the University of Nebraska-Lincoln (UNL), University of Nebraska, Omaha (UNO) and Texas Christian University (TCU) for a trip to Almaty, Kazakhstan in June to present a workshop and field trip on environmental chemistry and aquatic toxicology with scientists and students at Al Farabi Kazakh National University (KazNU).

Kazakhstan has unique environmental problems. As part of the former Soviet Union it was used for testing and storing nuclear weapons. Upon gaining its independence in the 1990s, the legacy of these nuclear tests and waste began emerging. Efforts were made to develop and train scientists to evaluate the extent and environmental impact of this radioactive waste.

The country also possesses the world's largest uranium reserves. Mining it has become a major industry in post-soviet Kazakhstan. Heavy metal contamination, a byproduct of that mining, has emerged as another major environmental issue. These combined contamination issues led to the Radioecology Research Group under the direction of Bolat Uralbekov at KazNU. The group has focused on the extent and potential effects of radioactivity and inorganic contamination in Kazakhstan.

Organic contamination from legacy pesticide is also an issue in agricultural areas of southern Kazakhstan.

These issues led to ongoing collaboration between researchers at UNL, UNO and TCU and the radioecology group at KazNU to evaluate the effects of agriculture on environmentally sensitive areas of the country, specifically the Syr Darya River that feeds the Aral Sea.

The Aral Sea has received global attention as diversion of its main tributaries for irrigation have resulted in the gradual desiccation of what was once the fourth largest saline lake in the world.

In early June, a two-day research workshop and three-day field study of the Syr Darya River basin was held. The goal was sharing advanced sampling and analysis techniques of environmental organic contaminants.

Following the workshop, researchers conducted a pilot field study to Kazakhstan's Syr Darya River watershed to collect fish tissue, water samples, sediment, and passive samplers to begin a multiyear study of the impact of past and present agricultural practices on fish species in this ecologically-stressed watershed.

The sampling expedition included the U.S. team and 10 from KazNU. It began at the Shardara reservoir near the southern Kazakhstan border with Uzbekistan, and ended near Koksaray, about 465 miles upstream from where the Syr Darya enters the Aral Sea.

The study provided insight into how emerging agriculture may impact the ecosystem and what chemicals are most common. It also revealed a lack of solid waste management resulting in widespread trash buildup throughout the region.

Transferring expertise in detecting and sampling these problem areas to collaborators in Kazakhstan will help them become an active participant in shaping policy and industry guidelines in the future.

Daniel Snow, director of NU's Nebraska Water Sciences Laboratory (part of the Nebraska Water Center); Alan Kolok, a biologist and director of UNO's Aquatic Toxicology Laboratory; Shannon Bartelt-Hunt, UNL environmental engineer; and Marlo Jeffries, an environmental toxicologist and biologist at TCU in Fort Worth, Texas, led the research expedition.

The National Science Foundation's Catalyzing New International Collaborations program provided funding for the Kazakhastan research project through a grant to UNL. The trip is one of an ongoing series of academic, research and student exchanges between NU and KazNU.

Nebraska's Dan Snow (left), Alan Kolok (second from right) and Shannon Bartelt-Hunt (right) with students in Kazakhstan

Website Captures Stories from Nebraska NRDs Early Leaders

Like its Unicameral, Nebraska's Natural Resources Districts (NRDs) are part of the state's innovative fiber. As local governance institutions, they guide how Nebraska manages groundwater, soil, trees, flood control and recreation projects that are vital to the state. They have helped shape Nebraska's environment for more than 40 years, are a model for other states, yet there has been little comprehensive history of how they were formed.

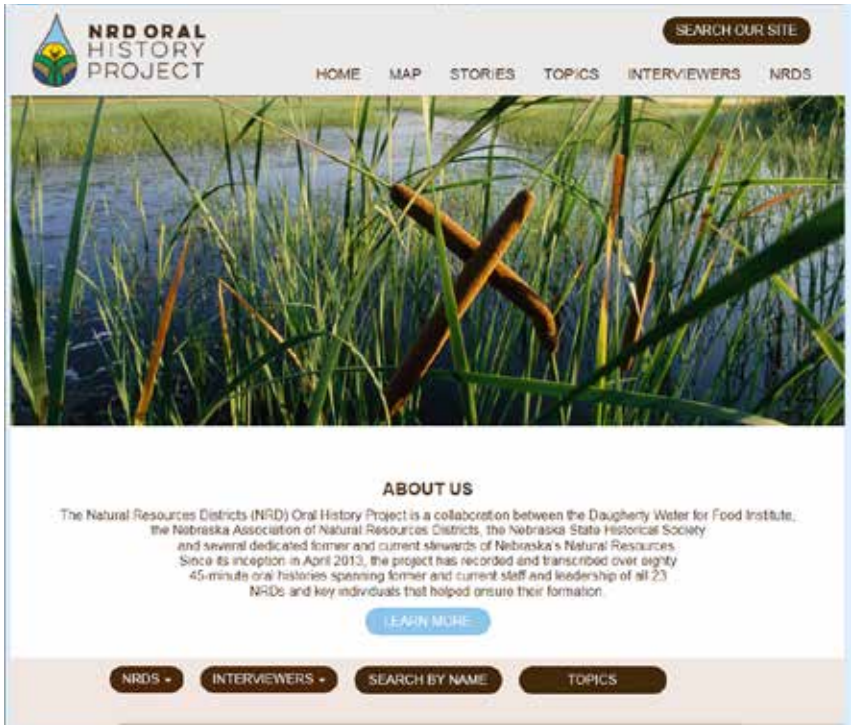
Thanks to the NRD Oral History Project, available online at nrdstories.org, early leaders tell the founding stories in their own words – and voices. The project was a collaboration between the Water for Food Institute, Nebraska Association of Resources Districts, Nebraska State Historical Society and several former and current stewards of Nebraska's natural resources. The website features 80 45-minute audio interviews with individuals from all 23 NRDs. Visitors can listen to interviews, read transcripts, look through photos and search stories via an interactive NRD map.

"It took a lot of gritty hours by our talented staff to bring this to life," said Jesse Starita, WFI education outreach associate. "Craig Eiting, WFI web developer and graphic design specialist and student interns Cindy Reyes-Cortes and Sandra Dizdarevic did an outstanding job of creating the website's design and navigation."

"One reason our state has this unique system is because the people telling these stories – ranchers, state senators, lawyers, hydrologists, agricultural economists – were united by their desire to create a better system to steward our land and water," Starita said.

The website launched at the NRD Annual Conference in Kearney, Neb. Sept. 27-29, 2015.

Learn more at nrdstories.org.



Water for Food Institute Policy and Technical Report Series

Nebraska's Natural Resources Districts

The Water for Food Institute published its first policy report in 2015, "Nebraska's Natural Resources Districts: An Assessment of a Large-Scale Locally Controlled Water Governance Framework," by Ann Bleed, Ph.D., P.E. Emeritus, and Christina Hoffman Babbitt, Ph.D.

The use of groundwater for agricultural purposes has increased significantly around the world in recent years, bringing with it important gains in yields and incomes. At the same time, however, this growth has led to rising concerns about the long-term sustainability of the resource. Water tables are dropping in many locations, largely as a result of inadequate governance that fails to ensure that groundwater withdrawals are below rates of aquifer recharge.

Against this background, good groundwater governance is being recognized as vital to ensure that the quantity and quality of the resource continues to be available to sustain agricultural systems for future generations. If properly managed, groundwater resources can play a key role in ensuring food and water security, especially in the context of a changing climate. But without good institutions, it is unlikely that societies will be able to maintain the groundwater supplies needed to meet human and environmental needs over the long-term.

The NRD framework operates at the center of one of the world's most important food producing regions and at a significant scale, in both land and water resource terms. There is more irrigated agriculture in Nebraska than in any other state in the U.S., and more than all but a handful of countries worldwide.

The report shares how Nebraska's water governance system has helped Nebraska effectively manage this complex environmental resource and lessons learned that may be beneficial as we work toward ensuring water and food security for our growing world population.

The report, titled "Nebraska's Natural Resources Districts" is available online at: waterforfood.nebraska.edu/publications.

Learning How Water, Energy and Food are Interconnected in Nebraska

The WFI hosted a three-day workshop on "Advances in Understanding the Water-Energy-Food Nexus for irrigated agriculture" on August 15-17. The interdisciplinary workshop was funded by USDA/NSF under their joint Water Sustainability and Climate competition. Participants came from WFI, UNL, the University of Illinois, the Desert Research Institute, NOAA, and Resources for the Future. The workshop included a day of presentations, a day of field trips to Central Nebraska visiting power districts and producers, and a day of planning for future research collaborations. More information on the workshop is on the WFI blog. The workshop was featured in the Kearney Hub and Omaha World Herald newspapers.

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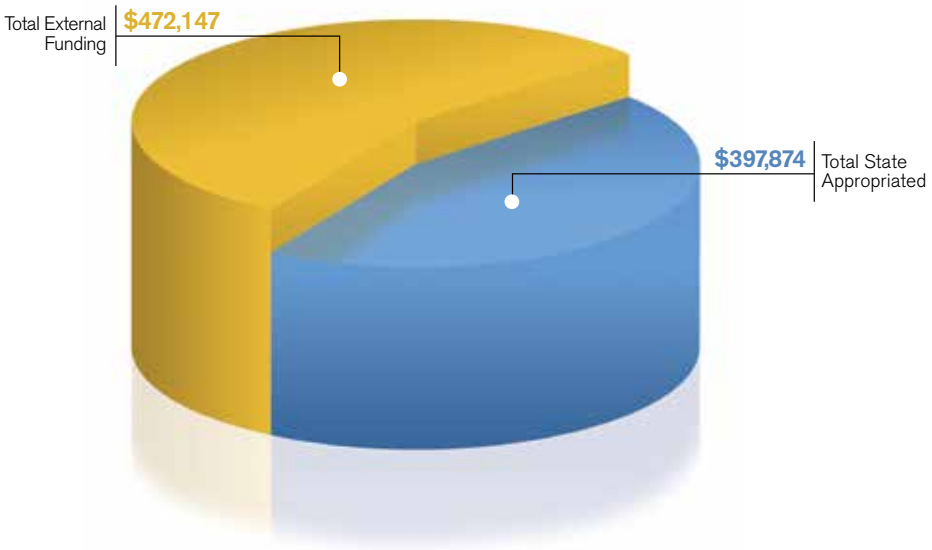
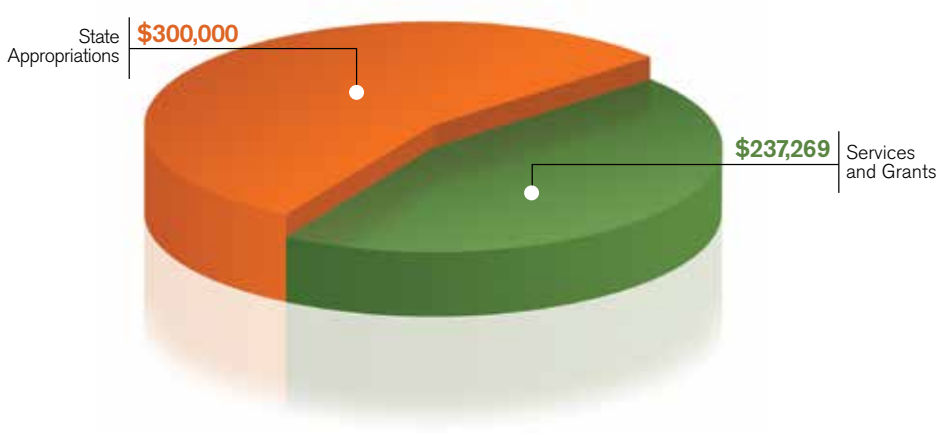
Nebraska Water Center Financials

Nebraska Water Center $870,021



Nebraska Water Sciences Laboratory $537,269



Fiscal Year 2015 Budget:

Nebraska Water Center

Total State Appropriated:
$397,874

Total External Funding:
$472,147

Total:
$870,021

Nebraska Water Sciences Laboratory

State Appropriations: $300,000

Services and Grants: $237,269

Total: $537,269

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