

## MEET THE INTERNS

**S**andra Dizdarevic is an undergraduate student working on a bachelor's degree in management information systems in the College of Information Science



*Sandra Dizdarevic*

and Technology at the University of Nebraska at Omaha. She came to Omaha from Sioux Falls, South Dakota, but is originally from Bosnia and spent several years in Serbia prior to moving to the U.S. She is fluent in Serbo-Croatian and English.

Sandra is helping build a dynamic and highly functional website for an oral history project about Nebraska's Natural Resources Districts (NRD). The website will allow users to search and filter through more than 80 audio interviews and transcripts. She is proud to be a part of the Robert B. Daugherty Water for Food Institute (DWFI) team and honored to work on the project, particularly because she will be able to help make the NRD's rich history accessible to a broad audience.

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

# Water Current

PART OF THE ROBERT B. DAUGHERTY  
WATER FOR FOOD INSTITUTE

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## Summer Expedition to Kazakhstan

**Brett Sallach and Steve Ress**



*Pictured at Al Farabi Kazakh National University in Kazakhstan are (from left) Dan Snow, Mariah Rakestraw, Brett Sallach, Bolat Uralbekov, Emily Hoehn, Leah Thorton, Marlo Jeffries, Alan Kolok, and Shannon Bartelt-Hunt (photo courtesy of Shannon Bartelt-Hunt).*

**E**arly this summer, eight U.S. scientists teamed with students from the University of Nebraska-Lincoln, University of Nebraska, Omaha and Texas Christian University for a trip to Almaty, Kazakhstan to present a workshop and field trip on environmental chemistry and aquatic toxicology with scientists and students at Al Farabi Kazakh National University.

With Russian influences in the north, China to the east, and the Middle East to the south, Kazakhstan has historically been at the center of trade and commerce throughout Asia along the Silk Road.

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## June Tour Visits Republican River Watershed in Nebraska and Colorado

**Steve Ress**

**T**his year's cooperative Water and Natural Resources Tour took nearly 70 participants of a guided tour of surface and groundwater irrigation and three-state compact litigation issues in the Republican River watershed in Nebraska and Colorado. The June 23-25 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 reexamine basin issues effecting water users, producers, communities and economics in the three states that share its waters since the tour had last gone there in 2008.

A series of newspaper articles, written by reporter Lori Potter of the Kearney Hub who

was on the three-day tour, nicely chronicles the primary stops, issues and topics of discussion, essentially being a virtual tour of the tour itself. The articles can be found at: <http://unlcms.unl.edu/ianr/water-for-food/nebraska-water-center/0708-2015-water-tour>

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,

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## From the Director

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

## A Busy, Productive and Diverse Summer

It has been a wonderfully busy and productive summer for faculty and staff associated with the Nebraska Water Center and Nebraska Water Sciences Laboratory since I last reported to you through this column.

In June we had one of the most successful joint water and natural resources tours that we have had in many years. The tour was held in the Republican River basin in Nebraska and Colorado, beginning and ending in Holdrege. It had been seven years since the tour last visited the basin, so we thought the time was right to reexamine the state of surface and groundwater irrigation issues there, as well as the three-state legal compact that has so much to do with how water users, producers and communities share the basin's waters.

Due to limiting logistical factors in touring the basin—primarily availability of motel rooms—we had originally planned on capping the tour at around 50 participants, but by the time we loaded the tour bus in Holdrege, we were closer to 70 participants. A good problem to have. Adding to our numbers in part were several students from the Nebraska State Irrigation Association's current Water Leaders Academy Class, and these young professionals and students are exactly who we want to expose to Nebraska water issues and the tour.

It was especially gratifying to have the help and co-sponsorship of all the Natural Resources Districts in the basin: the Upper, Middle and Lower Republican NRDs and Tri-Basin NRD, as well as UNL's Institute of Agriculture and Natural Resources and the Nebraska Rural Radio Association. These valuable co-sponsorships help us in planning the tour's agenda and in defraying costs to our participants, keeping the tour affordable.

As always, thanks to our primary co-partners the Central Nebraska Public Power and Irrigation District and the Robert B. Daugh-

erty Water for Food Institute and our peerless tour planner and host Mike Jess.

Also in June, Water Sciences Laboratory director Dan Snow, UNO/UNMC Aquatic Toxicology Laboratory director and biologist Alan Kolok, UNL environmental engineer Shannon Bartelt-Hunt and our colleague Marlo Jeffries, an environmental toxicologist at Texas Christian University in Ft. Worth, led a group of UNL, UNO and TCU students on a field expedition and workshops to Al Farabi Kazakhstan National University (KazNU) in Almaty, Kazakhstan. The environmental chemistry and aquatic toxicology field trip is part of a series of ongoing exchanges with KazNU that are proving to be beneficial to faculty and students in both Kazakhstan and here in Nebraska and Texas.

It was also quite special this summer to see that Bartelt-Hunt and Xu Li of UNL's Department of Civil Engineering and John Gilley of the USDA's Agricultural Research Service received this year's university research grand prize in the American Academy of Environmental Engineers and Scientists annual competition. Elsewhere in this issue you can read more on their award winning research on Influence of Selected Land Application Strategies on the Fate and Transport of Antimicrobials and Antimicrobial Resistance Genes in the Agricultural Environment.



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Jasmine Mausbach

**Jasmine Mausbach**, from Omaha, is an undergraduate student working on bachelor's degrees in environmental restoration and Spanish at the University of Nebraska-Lincoln (UNL). Jasmine is researching and assessing various student engagement programs to evaluate how they might be applied to programs at DWFI. She is also working on a project to promote DWFI's

Faculty Fellows on the website. In addition, she is developing a database of irrigation technology, irrigated land and irrigation productivity for every country in the world. The database will be used to create an interactive visual map with irrigation facts for each country.

She hopes to make a difference in the lives of those without enough food due to poor water management and farming techniques by assisting with international and local development. Her career goals include traveling the world, identifying environmental issues and proposing and implementing sustainable solutions. She hopes her experience at DWFI will help her achieve those goals.



Cindy Reyes

**Cindy Reyes** was raised in Lincoln, but hails from Gerber, California. She is a UNL undergraduate student working on a bachelor's degree in fine arts with an emphasis in graphic design. Cindy is designing a website promoting the history of Nebraska's NRDs. She is eager to gain experience working with a team, specifically in developing the NRD website with the

web developer. She hopes to offer a fresh design approach that captures the mission and achieves the goals of the project.

*(Editor's Note: DWFI includes a broad cross-section of post-doctoral, graduate and undergraduate students working with DWFI and Nebraska Water Center faculty and staff. We will periodically bring you introductions and updates on them through the Water Current).*

## WRAP Meets in June

Steve Ress

The University of Nebraska's Water Resources Advisory Panel (WRAP) met for ongoing discussions and a faculty research presentation on UNL's East Campus June 4.

UNL Institute of Agriculture and Natural Resources (IANR) associate vice chancellor Ron Yoder reviewed several pending faculty hires with the group, noting that four positions are under consideration or are in the hiring pipeline. Work with constituent groups such as the Nebraska Water Balance Alliance and others, will result in the hiring of two Extension irrigation engineers, one at UNL's Panhandle Research and Extension Center in Scottsbluff and the other at the West-Central REC in North Platte, Yoder said.

These are faculty members with joint research and extension appointments. They will work with the two hydrologists (groundwater and watershed) that are currently being hired. The hires are replacements within existing positions, not "new" position hires, he said.

Yoder said that IANR is also looking seriously at future hires in the study areas of climatology and weather. He and several WRAP members noted that Nebraska currently does not have a state office of climatology.

In considering hires in this area, Yoder said that IANR would ensure that any research resulting from these expertise areas would be relevant to the state and region.

Robert B. Daugherty Water for Food founding executive director Roberto Lenton told WRAP that DWFI is at the end of its first five-year operating period and that public reports on its progress during that time are being prepared. He also noted that DWFI's recent global conference in Seattle, Washington, had been an unqualified success and that proceedings from the event were available. The next global conference will be April 24-26, 2016 at Nebraska Innovation Campus in Lincoln.

Lenton also talked about the recently published DWFI policy report number one, a study of Nebraska Resources Districts: *An Assessment of a Large-Scale Locally Controlled Water Governance Framework* by Ann Bleed and Christina Hoffman Babbitt. The study is available publicly.

He noted personal plans to retire from the DWFI's executive director position sometime within the next year and said that IANR will handle the search for his replacement, beginning this fall.

Chittaranjan Ray, director of the Nebraska Water Center, talked about the upcoming water and natural resources tour to the Republican River basin, noting the tour was completely sold-out and also told WRAP about a planned early October brainstorming session for NU water faculty and collaborators.

Members of the WRAP also gave some short summary remarks. Mark Brohman of the Nebraska Environmental Trust talked about upcoming public meetings about NET activities and procedures,

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# Excellence in Environmental Engineering and Science Competition Winners

American Academy of Environmental Engineers and Scientists annual competition —

## 2015 Grand Prize - University Research

### Influence of Selected Land Application Strategies on the Fate and Transport of Antimicrobials and Antimicrobial Resistance Genes in the Agricultural Environment

**Entrant:** Department of Civil Engineering University of Nebraska–Lincoln and Agricultural Research Service, U.S. Department of Agriculture.

**Persons in Charge:** Xu Li and Shannon Bartelt-Hunt

**Entrant Profile:** This project was a collaborative effort between the University of Nebraska–Lincoln (UNL) and USDA-Agricultural Research Service (ARS).

Chartered in 1869, UNL is the state's land-grant university. As a public research university, UNL is listed by the Carnegie Foundation within the "Research Universities (very high research activity)" category. ARS is the principal in-house research agency of the USDA. ARS is charged with extending the nation's scientific knowledge and solving agricultural problems affecting Americans every day. ARS has more than 2,200 permanent scientists working on approximately 1,100 projects at more than 100 locations nationally.

Dr. Xu Li, assistant professor in the Department of Civil Engineering at UNL, has studied the fate and transport of antimicrobial resistance genes in agricultural systems, including soil, water, and livestock waste management structure. Dr. Shannon Bartelt-Hunt is an associate professor in the same department and has investigated the fate and transport of antimicrobial compounds in agricultural and municipal systems. Dr. Daniel Snow, director of the UNL Water Sciences Laboratory, has developed several methods for instrumental analysis of veterinary pharmaceuticals associated with livestock wastes.

Dr. John Gilley of ARS has extensive experience in conducting small-scale runoff simulations to evaluate contaminant transport following land application of livestock manures. Dr. Bryan Woodbury is a research agricultural engineer at the U.S. Meat Animal Research Center near Clay Center. His research specialty is livestock waste management.

Stacey Joy and Bhavneet Soni were the graduate students working on the project. David Parker and David Marx also helped with the project.

### Complexity of the Problem

Because of its high organic matter and nutrient contents, livestock manure is often land applied as a soil conditioner. Links between the presence of antibiotics and antibiotic resistance genes (ARGs)

in livestock manure and the environmental occurrence of these constituents in soil and water are uncertain, due in part to a lack of quantitative studies documenting these links. In addition, little is known about the temporal trends of antibiotics and ARGs in soil following land application of manure and the effects of commonly used agricultural conservation practices on the movement of antibiotics and ARGs in runoff from manure-amended fields. Without this information, it is challenging for livestock producers and environmental engineers to

- 1) estimate the amount of antibiotics and ARGs remaining in soil over time and
- 2) predict the loadings of antibiotics and ARGs in agriculture runoff.

### Demonstration of a Comprehensive and Integrated Approach

This project focused on antibiotics and ARGs in swine manure. Multiple aspects of manure land application strategies were tested to determine their influences on the fate and transport of antibiotics and ARGs in soil and in runoff. First, three commonly used land application methods (i.e., broadcast, injection, and incorporation) were tested. Then, narrow grass hedges planted immediately downslope from manure-amended land were investigated for their effectiveness to reduce the transport of antibiotics and ARGs in runoff. Finally, the effects of time elapsed between manure application and rainfall was investigated to determine the effects of application timing.

Plot tests were employed in the field to better simulate the real world scenario. With at least three plots for each treatment combination, we were able to test the statistical significance of our findings. Antibiotics and ARGs in both soil and runoff were quantified using state of the art methods. Results were synthesized to provide a comprehensive evaluation of the impacts of various land application strategies on the fate and transport of antibiotics and ARGs in the agricultural environment.

### Quality and Importance of This University Research

Pork production is a significant agricultural enterprise in the U.S., with the majority of producers located in the Midwest and North Carolina. This study provides swine producers and environmental engineers with information concerning best management practices for manure land application. Our cumulative related work has resulted in five papers published or accepted for publication in peer-reviewed journals such as *Environmental Science and Technology*<sup>1</sup>, *Science of the Total Environment*<sup>2</sup>, *Journal of Environmental Quality*<sup>3</sup>, and *Transaction of the American Society of Agricultural and Biological Engineers*<sup>4,5</sup>



## Originality and Innovation

Little is known about how commonly used agricultural practices may influence the fate and transport of antibiotics and ARGs in the field. Our study showed that injection and incorporation methods lead to lower total mass of antibiotics and lower levels of ARGs in runoff than did broadcast<sup>1</sup>. The impacts of the land application methods on the fate of antibiotics in soil depended on the compounds' susceptibility to photodegradation. When manure slurry was stored under anaerobic condition, chlortetracycline and tylosin decayed following first-order reaction kinetics with a half life of 1 day and 10 days, respectively<sup>2</sup>. The corresponding chlortetracycline and tylosin resistance genes decreased 1 to 3 orders of magnitude in relative abundance over the course of 40 days. Finally, our results show that narrow grass hedges were effective in reducing tylosin and its corresponding resistance gene *erm(B)* in agricultural runoff<sup>3</sup>. This project provided new information

on the effectiveness of various land application strategies on the fate of antibiotics and ARGs in soil as well as their movement in runoff following land application of swine manure.

This project was built on our previous studies on this topic. In previous studies, we quantified the levels of antibiotics and ARGs in the liquid and solid phases of livestock waste management structures<sup>6</sup>, and discovered the occurrence of ARGs in extracellular DNA matrices in livestock wastes<sup>7</sup>.

## Project Contribution to Social or Economic Advancement

The project provided key information on the environmental fate and transport of antibiotics and ARGs in soil and runoff following land application of swine manure slurry. This information is critical in developing land application strategies that can be implemented in the field to reduce the potential for public health concern.



John Gilley, USDA ARS, directed field-testing at UNL Roger's Memorial Farm. Here he stands near a field well where groundwater was extracted and used in rainfall simulation tests.



UNL undergraduate students were recruited to work on field-testing for the project in the summer. Some went on to become graduate students while continuing to work on the project.



Field tests were conducted at UNL's Roger's Memorial Farm. To better simulate real world scenarios, swine manure was collected from a facility at the USDA Meat Animal Research Center and land applied by a commercial company.

## Measuring the Cleanliness of Valuable Resources at UNO

Susan Houston Klaus

Alan Kolok is an expert in aquatic toxicology — the study of how chemicals and natural materials affect everything from tiny organisms to whole ecosystems. The University of Nebraska, Omaha (UNO) professor makes important discoveries close to home and far away. Nearby is his work at the Elkhorn River Station, where UNO students work alongside an international doctoral student and another from the University of Nebraska Medical Center (UNMC). Kolok's recent research at the Elkhorn River Station looks at the sediment load the river carries.

"The water is the color of chocolate milk in the spring," Kolok says, because it carries small grains of sand, silt and clay in high concentrations. That's significant because that sediment is important to the transport of chemicals. Even though surface water doesn't lead to an adverse impact on area fish, the sediment does.

Lately, he's been interested in examining how fish might pass sediment through their digestive system. While research to date has never shown ingestion of the sediment, he and his team believe that very fine, potentially highly toxic particles are being captured in the gills of the small fish they have studied.

His look at local waters will expand to a new station being built on the Missouri River in Haworth Park in Bellevue. There, scientists will have access to real-time quality data.

They'll also be able to make direct comparisons of the 300-mile-long Elkhorn River to the much longer Missouri River, looking at how global climate change, weather patterns and storm events impact both bodies of water.

Kolok is also making important finds in Colombia, Chile, Kazakhstan and elsewhere.

In Colombia, he studied water carried in the runoff from gold mining operations — which could carry mercury. With funding from a National Science Foundation grant, he and colleagues sampled fish from local mercados (markets) to look for concentrations of mercury.

They found higher concentrations in whiskered catfish. Talking to local fishermen, they traced the fish to a geographical area.

The results of that study were published in a journal article in 2012 — generating much interest and being among the two most often cited papers he's ever published, Kolok says.

More recently, Kolok and a UNL counterpart (Dan Snow, director of the Nebraska Water Center's Nebraska Water Sciences Laboratory) traveled to Al-Farabi Kazakh National University to teach a nine-day workshop in ecotoxicology.

The curriculum was aimed at helping students better understand similarities in water quality issues between the Syr Darya River basin in southern Afghanistan and water basins in the U.S. Midwest.

"We were able to introduce ideas in ways the students hadn't thought about before," Kolok says. "You're walking into an environment where you have a blank page in front of you, where you have the opportunity to effect change on a fundamental level."

What started as 20 students on the first day grew to a curious group of 40 midway through the workshop.

"I have the utmost respect for the individuals at the university there. They had a desire to be competitive on an international level. It's a responsibility and an honor" to have taught them, he said.

The experience at Al-Farabi KazNU continues this summer as Kolok and an undergrad student conduct another, more in-depth workshop. He's also received a three-year grant from the Republic of Kazakhstan to fund research on one of that country's rivers.

*Editor's Note: Kolok is a professor of biology and director of UNO's Aquatic Toxicology Laboratory. He is also interim director of the Center for Environmental Health and Toxicology, College of Public Health at UNMC and a longtime professional colleague of the Nebraska Water Center and Nebraska Water Sciences Laboratory. This article was first published in the Summer 2015 issue of UNO Magazine).*

## Summer Expedition to Kazakhstan *continued from page 1*

Its history is also unique in terms of environmental problems. As part of the former Soviet Union, Kazakhstan was used for testing and storing nuclear weapons. Upon gaining its independence in the 1990's the legacy of these nuclear tests and waste began to emerge. Efforts were immediately 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 Dr. Bolat Uralbekov at Al Farabi Kazakhstan National University

(KazNU). The group has focused on the extent and potential effects of radioactivity and inorganic contamination in Kazakhstan.

As Kazakhstan's economy diversifies, new sources and types of contamination are likely to emerge. Organic contamination from legacy pesticide use is already an issue in agricultural areas of southern Kazakhstan, and will likely increase from accelerated agricultural development.

All this has 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.

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## From the Director *continued from page 2*

In July I was honored to be able to deliver a keynote lecture at the 10th International Water Association water reuse meeting in Harbin, China. The topic of my talk was Vegetable Crop Uptake of Pharmaceuticals during Irrigation with Recycled Water.

During this trip, which was funded by the U.S. Department of Agriculture with some help from the University of Nebraska, it was very interesting to see the rapid changes that are occurring inside China with respect to their rising standard of living, investment in technology and infrastructure and expanding agricultural production. It is truly a country on the move in many, many ways.

We were pleased this summer to learn that the Nebraska Water Center has received a water quality research grant from the Nebraska Environmental Trust for more than \$180,000 to develop a spatial index tool for Nebraska that will prioritize chemicals for their potential to leach from the land surface to groundwater.

This new tool will use soil, chemical and hydrologic factors for assessing relative leachability of chemicals in a geographic information system (GIS) framework.

In early August, our communicator, Steve Ress, and I traveled to Sutherland for the first of what I know will be many more successful field days and symposiums by the Nebraska Water Balance Alliance (NEWBA). We have come to value this grass-roots, producer-driven organization more-and-more over the past few years for their interests in effective management of water resources. They are successfully bringing the many players in the Nebraska water arena together for frank discussions on how we can mutually benefit each other in the search for real answers to questions of how producers can use available water more efficiently through innovative water management.

NEWBA board chair and producer Roric Paulman did a wonderful job in making sure that all of the state's water "players" had a chance to be included in this field day/symposium. Looking forward to seeing how much this event expands next year.

Late summer and fall will be just as busy as our summer has been. In September, our communicator, Steve Ress, will be busy helping lead UNL Extension and research exhibits at the annual Husker Harvest Days irrigated farm expo near Grand Island. This year's exhibits are focused on "Successfully weathering extremes" to help agriculture

producers and all Nebraskans get a better handle on how our university can help them deal with and prosper in a time of increasing extremes in our weather patterns.

On October 7, 2015, we will host a water faculty retreat at the University of Nebraska at Kearney and the primary focus will be to present the expertise of NU faculty to federal, state, and local partners and to explore opportunities to work together in the future.

We have also begun planning our October 2016 water/water law symposium and conference that will be held at Nebraska Innovation Campus here in Lincoln.

Finally, I want to recognize the oftentimes unnoticed, but very important work of our Nebraska Water Center Advisory Board. The board's 14 members work largely through subcommittee assignments that help us with outreach and communications, research support, the water sciences laboratory and other critical areas key to the Nebraska Water Center's success. You will see their names and involvement areas on the board in an article elsewhere in this issue.



*Nebraska Water Center director Chittaranjan Ray made a recent research and collaboration trip to China.*

## June Tour Visits Republican River Watershed in Nebraska and Colorado *continued from page 1*

including UNL undergraduate, graduate and exchange students and several students in the Nebraska State Irrigation Association's current Water Leaders Academy class.





## Nebraska Water Center Advisory Board

The Nebraska Water Center's (NWC) Advisory Board helps advise and strengthen the NWC as it carries out its core missions of supporting water-related research, education and outreach programming and sharing information with its constituency and the public.

The advisory board combines many existing advisory functions into one body. Examples of issues where their advice may be sought include research needs, particularly in Nebraska; events and programs for facilitating interdisciplinary research; shaping of academic programs; seed grant awards; and suggestions for outreach event topics.

Current members of the board, and their subcommittee assignments, are:

- **John Bender**, Nebraska Dept. of Environmental Quality  
*Science Advisory and Outreach/Communications*
- **Dean Eisenhauer**, UNL Dept. of Biological Systems Engineering (emeriti)  
*Science Advisory*
- **Thomas Franti**, UNL Dept. of Biological Systems Engineering  
*Water Sciences Laboratory*
- **Shannon Bartelt-Hunt**, UNL Dept. of Civil Engineering  
*Water Sciences Laboratory*
- **Jesse Bradley**, Nebraska Dept. of Natural Resources  
*Science Advisory and Outreach/Communications*

- **Rick Holland**, Nebraska Game and Parks Commission  
*Science Advisory and Research Support*
- **Alan Kolok**, UNO Nebraska Watershed Network and UNMC  
*Water Sciences Laboratory*
- **Dana Divine**, UNL Conservation and Survey Division, School of Natural Resources  
*Science Advisory*
- **John Miyoshi**, Lower Platte North NRD  
*Outreach/Communications*
- **Tim Shaver**, UNL Department of Agronomy and Horticulture, West Central Research and Extension Center, Scottsbluff  
*Research Support*
- **Steve Thomas**, UNL School of Natural Resources  
*Water Sciences Laboratory*
- **Ron Zelt**, USGS Nebraska Water Science Center  
*Science Advisory and Research Support*
- **Dan Miller**, USDA-ARS  
*Water Sciences Laboratory*
- **Karrie Weber**, UNL Department of Earth and Atmospheric Sciences  
*Water Sciences Laboratory*
- **Chittaranjan Ray**, Nebraska Water Center  
*Water Sciences Laboratory*

## Search begins for next Robert B. Daugherty Water for Food Institute Executive Director

The University of Nebraska announced today that it has begun an international search for the next executive director of the Robert B. Daugherty Water for Food Institute. The next director will succeed founding executive director Roberto Lenton, who in February announced his intention to step down by early 2016 after serving in the role since 2012.

"Roberto has done a wonderful job during the initial developmental years of the Daugherty Institute and we are forever indebted to him," said Ronnie Green, University of Nebraska vice president for agriculture and natural resources. "The institute is now firmly established thanks to his exemplary leadership and the work of our faculty, staff and partners in Nebraska and around the world. The next executive director will have a solid foundation on which to build, and will have an attractive opportunity to engage educational, research and funding partners from around the world to further establish the Daugherty Water for Food Institute as the premier institution addressing water, people and the environment in food production systems."

University of Nebraska President Hank Bounds said, "Developing sustainable solutions for feeding the growing global population is one of the most urgent challenges facing the world today. The University of Nebraska needs to own this conversation. My interactions with faculty, staff and students across the campuses and at research and extension facilities across the state tell me we are well-positioned to do so. I thank Roberto for his work in getting the institute off to a very successful start, and look forward to the next phase of growth in which we will continue to impact the lives of people in Nebraska and around the world."

Green said he has appointed an advisory committee to assist in the search. The committee will be co-chaired by Bob Meaney, retired senior vice president of Valmont Industries, and Ron Yoder, associate vice chancellor for the University of Nebraska-Lincoln Institute for Agriculture and Natural Resources, and includes representatives from all four NU campuses as well as external stakeholders.

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# Water and Natural Resources Tour Explores Republican River Basin

Jasmine Mausbach

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 travelled across Nebraska from Holdrege into the northeastern farmland of Colorado. I was given the opportunity to see the effects of groundwater depletion firsthand 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.

From the experience, 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 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, Nebraska, 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 benefitted 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 travelling 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](http://watercenter.unl.edu).



*Student intern Jasmine Mausbach at an outlet for the N-CORPE augmentation pipeline while on the June water and natural resources tour.*



## June 23-25 Water and Natural Resources Tour Visits Republican River Basin



*Bartley Canal diversion dam.*



*A rest stop at historic Champion Mill.*



*Marsha Trompke (left) looks at natural spring water near Champion.*



*Nebraska Bostwick Irrigation District manager Mike Delka talks at the Franklin diversion canal at Harlan County dam.*



*Heading to an invasive species eradication project downstream from Harlan County Reservoir.*



*Upper Republican NRD manager Jasper Fanning talks about the N-CORPE augmentation project.*





U.S. Army Corps of Engineers' Harlan County Dam near Alma.



Loading boats for a tour of Harlan County Reservoir.



Getting back on the bus after a stop at the Nebraska College of Technical Agriculture in Curtis.



The tour often comes close to "offroading" to get to destinations.



Listening to a rundown on opportunities for students at UNL's Nebraska College of Technical Agriculture in Curtis.



A lunch stop at Swanson Reservoir, west of McCook.



## June 23-25 Water and Natural Resources Tour Visits Republican River Basin



*A tour of a Valmont Industries plant in McCook.*



*Michael Young (center, left) checks a basin map at the Bartley diversion canal.*

## Record Rains in May



*Heavy rains in May temporarily flooded many parts of Lincoln, including stretches of Antelope Creek, which runs just north of the Nebraska Water Center's new office on Nebraska Innovation Campus and the Devaney Center that is home to Nebraska women's volleyball (Christopher Neale photos).*



## Summer Expedition to Kazakhstan *continued from page 6*

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.

The workshop was followed by the 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.

*continued on page 14*

The process is laborious, expensive, time-consuming, and subject to human error. In addition, taking readings only once a year after the irrigation season does not provide sufficient data on how and when water is used during the growing season in relation to crop water requirements. Consequently, water managers at the NRDs lack accurate, detailed and timely enumeration of water quantities that can be used for planning irrigation during the irrigation season.

To effectively manage its long-term water usage in a sustainable and equitable manner, the NRDs need a more accurate and efficient method for continuous data collection. Accurate measurement and documentation of the quantities of water use can provide critical input data for improving the integrated water management and planning processes.

A centralized water use database is described as an organized collection of water use information located and maintained in one location and not spread across multiple sites. There are several advantages of a centralizing the database, including ability to access all information in one location; easier organization in a single location; faster database searches because there is no need to check multiple locations; easily upgradable to handle more information by simply adding servers to the database location; and a centralized database is easier to physically secure.

This project uses the most appropriate and cost effective, yet advanced technology for automated irrigation water measurements and data collection system. Irrigation fields are remotely connected to a centralized database. The system consists of transmitters installed at the bases of existing irrigation flow meters. The transmitters transmit pulses representing irrigation flow rates to stand alone telemetry units that convey the data to telemetry gateway (server).

Other related water use data/variables that are measured and transmitted through the telemetry system include rainfall, potential evapotranspiration and soil moisture. The system can record and deliver real time irrigation flow and other data via the Internet to a centralized monitoring computer. This time and transportation costs by eliminating the need to drive to each meter for site reading and manually recording flow data.

The project is being implemented under the aegis of the Nebraska Agricultural Water Management Network (NAWMN). Irmak established NAWMN in 2005 to transfer high-quality, research-based information to farmers and crop consultants to enhance their decision-making process and adoption of newer tools and technologies that will enable irrigators to conserve water and energy resources and enhance crop water productivity.

It has an established network of more than 1,200 farmers, crop consultants and 17 NRDs as partners/cooperators, along with Nebraska Extension educators, Natural Resources Conservation

Service (NCRS), and irrigation districts. Currently, other NAWMN projects include research-based tools such as evapotranspiration gages (ET gages; atmometer), and soil moisture sensors installed in many parts of Nebraska in a coordinated form.

Strong and effective collaboration between UNL and various state and federal water management agencies to maximize net benefits of irrigation water management in crop production will continue to be very important in Nebraska, because many areas in the state are involved in significant management changes to conserve water. Education and new information about the use of appropriate technologies are delivered to agriculture professionals and irrigators through NAWMN. Irrigation water metering and real-time monitoring of irrigation water implemented through automated water use database project will make it possible for greater water-saving strategies to be developed on a watershed/basin scale.

Within the MRNRD automated water use database project, 30 participating farms were selected from among all registered irrigation well permits in MRNRD. Participating farms have access to monitor their own irrigation data via the internet using their home computers.

With real-time data delivery capability, water management staff at the NRDs and irrigators are able to monitor water-use quantities from their home computers, and set alarms (if desired) to indicate high/low usage rates, and track data by individual farm number. When fully implemented, the benefits of this project will be a significant reduction in cost of data collection and processing. When accurate and timely irrigation flow measurement is correlated with crop water requirement, water usage by growers can be reduced by an estimated 20 to 40 percent. The quality of groundwater which is a source of drinking water for more than 19,000 people living in the project area will be protected through the reduction of deep percolation of irrigation water that carries nitrate nitrogen out of the root zone into the groundwater.

Surface water quality will also benefit from this project as better water management will reduce irrigation water runoff that would impact streams and lakes with sediments laden with agricultural chemicals. These benefits will be achieved with training the farmers in irrigation best management practices supported by research-based data from this project. Another benefit is to help enforce compliance with the IMP ground water pumping limits

The project has already established protocol for remote data reading, transmission and archiving to a centralized database. An NRD-wide Geographic Information System (GIS) is being developed for cataloging data and irrigation system locations within MRNRD. The GIS will be used for coordination of inputs and reporting of the data on crop and soil type on a weekly and monthly basis. In addition, agricultural and environmental information pertinent to irrigation

*continued on page 14*



## WRAP Meets in June *continued from page 3*

Bob Bettger discussed his interest in wetlands restoration projects and Jerry Kenny, executive director of the Platte River Recovery Implementation Program talked about PRRIP current activities, including progress being made on Least Tern and Piping Plover nesting.

WRAP coordinator Rachael Herpel reviewed WRAP survey results on a variety of NU research and resource-related topics. The member survey noted, among other things, that some of the most highly utilized NU resources were Extension publications, including NebGuides and the broad spectrum of available experts and research capabilities.

Among the most highly valued NU resources identified by the survey were information on crop and water best management practices, the Coop unit and School of Natural Resources, the Conservation and Survey Division, agricultural engineering, ET research and analysis and irrigation management recommendations, and CALMIT research on land use changes.

WRAP members also signaled that top priorities in NU's role in addressing high priority water issues should be in the areas of research from field to watershed scales and presenting the best available science so farmers, managers, policy-makers and others can make informed decisions.

The survey addressed many other areas of NU water research, outreach and education activity, including where NU will need to be in the next 5-10 years in both research and resources; the best ways to distribute research results; and how success should be measured.

After a short break, WRAP reconvened to hear a research presentation by Haishun Yang of UNL's Department of Agronomy and Horticulture.

WRAP will next meet September 24.

## A NET Summary *continued from page 13*

water use will be gathered from other existing sources and will be geographically referenced.

Actual crop evapotranspiration and irrigation water requirements are calculated for the crops grown, and the crop water requirements are compared with the actual amount of irrigation water applied to

assess the irrigation performance practiced by farmers. Educational programs are being conducted to make recommendations on improvements in irrigation management, mainly to bring irrigation water requirement, and actual water applied close to each other to minimize over- or under-irrigation.

## Summer Expedition to Kazakhstan *continued from page 12*

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.

Helping lead this trip were Dan Snow, director of NU's Nebraska Water Sciences Laboratory (part of the Nebraska Water Center); biologist Alan Kolok, who directs UNO's Aquatic Toxicology Laboratory; UNL environmental engineer Shannon Bartelt-Hunt; and Marlo Jeffries, an environmental toxicologist and biologist at Texas Christian University in Dallas, Texas. U.S. students included Emily Hoehn and Brett Sallach

from UNL, Mariah Rakestraw from UNO, and Leah Thorton from TCU.

Bolat Uralbekov, environmental chemist and head of the Department of General and Inorganic Chemistry at KazNU, provided student, technical and logistical support for both the workshop and field expedition.

Trip expenses were paid for from a grant to UNL from National Science Foundation (NSF)-funded Catalyzing New International Collaborations (CNIC) program. The trip is one of an ongoing series of academic, research and student exchanges between NU and KazNU.

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## New Mailing Addresses

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Lincoln, NE 68588-6203

*Nebraska Water Center*  
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P.O. Box 886204  
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## Search begins for Water for Food Institute Executive Director *continued from page 8*

Committee members are:

- Charlie Bicak, Senior Vice Chancellor for Academic and Student Affairs, UNK
- Ken Cassman, professor and Daugherty Chair and Fellow, Agronomy & Horticulture, UNL
- Tom Farrell, Senior Advisor for International Affairs, UNL
- Lilyan Fulginiti, Professor and Daugherty Fellow, Agricultural Economics, UNL
- Bruce Grogan, Associate Director, Center for Global Health & Development, College of Public Health, UNMC
- Mike Hayes, Professor and Daugherty Fellow, Director of National Drought Mitigation Center, School of Natural Resources, UNL
- Peter Longo, Professor, Political Science, UNK
- Lee Orton, Executive Director, Nebraska State Irrigation Association, and, Nebraska Well Drillers Association

- Christine Reed, Professor and Daugherty Fellow, School of Public Administration, UNO
- Chittaranjan Ray, Professor and Director, Nebraska Water Center, UNL
- Scott Snyder, Associate Vice Chancellor for Research and Creative Activity, UNO
- Anthony Schutz, Associate Professor, College of Law, UNL
- Harkamal Walia, Associate Professor and Daugherty Fellow, Agronomy & Horticulture, UNL

The committee will be assisted by Kim Morrisson of Diversified Search, a professional consulting firm engaged by the university. Green encouraged members of the university community and other stakeholders to recruit potential candidates for the position or send nominations to Morrisson at [Kim.Morrisson@Divsearch.com](mailto:Kim.Morrisson@Divsearch.com).

## Big Sky, Montana Bests Tap Taste Test

The American Water Works Association announced that the Big Sky County Water and Sewer District, Big Sky, Montana, has won the 11th annual “Best of the Best” Tap Water Taste Test. Second place went to Universal City, Texas. The event, composed of regional winners from water-tasting competitions across North America, was held at AWWA’s recent conference and exposition in Anaheim, California.

Big Sky County Water and Sewer District is a special purpose unit of government organized to regulate and operate the public water and sewer systems of Big Sky. Their source water is untreated groundwater.

Third place was a tie between Albuquerque Bernalillo County Water Utility Authority and last year’s champions the Boston Water and Sewer Commission. The People’s Choice award winner, as determined by the conference attendees, went to Champlain Water District of South Burlington, Vermont.

Other “Best of the Best” participants included: Arcadia Water Utility, Arcadia, Wisc.; City of Anaheim Public Utilities Department, Anaheim, Calif.; City of Chelsea, Mich.; City of Fargo, N.D.; City of Hamilton, Ohio; Latham Water District, Latham, N.Y.; City of Tallahassee Underground Utilities, Tallahassee, Fla.; City of Tulsa, Okla.; City of Universal City, Texas; Chester Water Authority, Chester,

Penn.; Duck River Utility Commission, Tullahoma, Tenn.; Jordan Valley Water Conservancy District, Herriman, Utah; Georgetown County Water & Sewer District, Pawley’s Island, S.C.; Henry County Water Authority, Jackson, Ga.; Leeds Water Works Board, Leeds, Ala.; Lincoln Water System, Lincoln, Neb.; Merchantville Pennsauken Water Commission, Pennsauken, N.J.; Moorhead Public Service, Moorhead, Minn.; North Park Public Water District, Machesney, Ill.; Puerto Rico Aqueduct and Sewer Authority, San Juan, P.R.; Spotsylvania County Utilities, Fredericksburg, Va.; Valley Water District, Puyallup, Wash.; Washington Suburban Sanitary Commission, Laurel, Md.; WaterOne, Kansas City, Kan., and West Virginia American Water, Charleston, W.V.

A judging panel rated each water system on flavor.

Previous winners are Boston Water and Sewer Commission (2014), Oklahoma City Water and Wastewater Utility (2007 and 2013), Fremont, Neb. (2012), Greenville, S.C. (2011), Stevens Point, Wis. (2010), Macon (Ga.) Water Authority (2009), Louisville (Ky.) Water Company (2008) and Illinois American Water, Champaign District (2006 and 2005).

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## Centralized Water Use Database for the Republican River Basin in Southwest Nebraska: A NET Summary

The way irrigation water use is monitored and documented is bound to change with the development of new technologies that are capable of remotely reading irrigation flow meters and archiving the records in a centralized water use database.

University of Nebraska–Lincoln (UNL) irrigation engineers Suat Irmak and Lameck Odhiambo, both of UNL's Department of Biological Systems Engineering, are implementing a next-generation pilot project on automated irrigation water use monitoring and data collection for addressing current and future water issues.

The project is being piloted in the Middle Republican Natural Resource District (MRNRD) and was funded by the Nebraska Environmental Trust (NET) for a three year period (2012-2015). The long-term goal is to establish a basin-wide automated irrigation water use monitoring and database that can enhance accurate measurements and proper documentation of water use in the Republican River Basin.

MRNRD is one of 14 NRDs charged with promoting a sustainable balance between water use and supply so that the area's economic viability in terms of sustainable use of water resources can be achieved and maintained for both the near and long terms. MRNRD

in collaboration with three other NRDs that cover the Republican River Basin on the Nebraska side (i.e. Upper Republican NRD, Tri-Basin NRD, and Lower Republican NRD) have developed a joint Integrated Management Plan (IMP) for ground water and surface water resources.

One of the key elements needed for successful IMP implementation is accurate monitoring and documenting the amount of groundwater withdrawal for irrigation. Currently, groundwater withdrawals are monitored from a network of metered irrigation wells.

There are over 24,000 active irrigation wells on the Nebraska side of the basin, with about 3,300 of those in the MRNRD. The present practice of gathering irrigation water use data is by NRD technicians to manually read irrigation meters once a year after irrigation season.

That data is then manually entered and compiled in an MS Access database and stored at the NRD.

*continued on page 13*