

Student Support Program Outputs, Outcomes and Impacts

The Robert B. Daugherty Water for Food Global Institute (DWFI) initiated its Postdoctoral and Student Support Programs in 2014. Since that time postdoctoral scholars, 42 graduate students, and 21 undergraduate students have received support via the program. At least 15 have graduated and are currently working in their field or have gone on to graduate programs. The following details their achievements.

Round One

The institute first provided undergraduate, graduate student and postdoctoral support to faculty who were selected following a call for proposals in 2014. Support was awarded for two postdocs, five graduate students, and two projects with undergraduate students. By FY19 a small amount of support continues for Francisco Munoz-Arriola's program. Outputs include presentations, grants and publications. The other faculty who have received support are: Vijendra Boken, UNK Geography & Earth Science; Carrick Detweiler, UNL Computer Science & Engineering; Trenton Franz, UNL School of Natural Resources; Patricio Grassini, UNL Agronomy & Horticulture; Alan Kolok, UNMC College of Public Health and UNO Biology; Robert Oglesby, UNL Earth & Atmospheric Sciences; Julie Shaffer, UNK Biology; and Harkamal Walia, UNL Agronomy & Horticulture. Outcomes include a significant leveraging of RBDF resources to implement the Platte Basin Timelapse project and achieve changes in knowledge, action and ultimately water and food security.

Daugherty Fellows – Postdoctoral Positions

DWFI Faculty Fellows were invited to submit applications for Daugherty Fellows support. Daugherty Fellows postdoctoral positions were awarded to:

- **Francisco Munoz-Arriola**, Assistant Professor in Hydroinformatics and Integrated Hydrology, UNL Biological Systems Engineering and School of Natural Resources, for the project: *Software Development for Water- and Agriculture-resources Data and Information Access: the case of the Water for Food Interoperability System (WaFIS)* - Dr. Munoz-Arriola has worked with a number of postdoctoral fellows throughout the course of this project funding period: **Carlos Ancona Villareal, Lorena Castro-Garcia, Martin Otto, Gengxin (Michael) Ou, Antonio Rosales Marinez, and Emannelle Ruelas-Gomez.**

This team is working on the implementation of three modeling frameworks to assess water resiliency in agricultural working lands. These approaches include:

- a) numerical modeling of flooding events in the High Plains, the Mexican Plateau (Mexico), and the Mumbai metropolitan area (India);

- b) data-driven modeling applied to integrate groundwater, remote sensing, and field land surface hydrologic variables in Nebraska, resulting in the development of a forecasting platform (<https://nebraskagw.shinyapps.io/app1/>); and
- c) statistical modeling applied in water resources planning in the Platte and Missouri River Basins, as well as in Mexico.

In addition to DWFI, these initiatives were funded by CONACYT (National Council for Science and Technology in Mexico), the Indian Department of Science and Technology, and the Indo-US Science and Technology Forum (through the WARI fellowships). This team is also working to develop the Water for Food Information System (WaFIS). Given the continuous changes in information technologies, the team has found a niche in “Hydroclimatic Analytics, Synthesis, and Modeling.”

Presentations:

- Castro-Garcia, L., G. Lopez-Morteo, and F. Munoz-Arriola. Water for Food Information System. *2014 Water for Food Conference*, Seattle, WA. October 21. (poster)
- Munoz-Arriola, F., A. Mohammad Abadi, K. Smith, M. Morton, D. Rico, L. Castro-Garcia, and G. Lopez-Morteo. Achieving Water Sustainability in the Era of Information Technology: The Role of Hydroinformatics and Integrated Hydrology. *2014 Water for Food Conference*, Seattle, WA. October 21. (poster)
- Castro---García, L, G. López---Morteo and F. Muñoz---Arriola. 2014. Water for Food Interoperability System (WaFIS). *2014 Water for Food Global Conference*. Seattle, Washington. October 22.
- Munoz-Arriola, F. From Paper to Big Data: Interoperability of Water-Food-Energy Data. Side Event. *2014 Water for Food Global Conference*. Seattle, Washington. October 22.
- Munoz-Arriola, F. R. Walko, A. Mohamad Abadi, L. Castro-Garcia. Toward Improving Predictability of Extreme Hydrometeorological Events in the Northern High Plains. *American Geophysical Union, Fall Conference*, San Francisco, CA. December 18, 2014.
- Rico, D., C. E. Ancona-Villareal, A. A. Rosales-Martínez, L. Castro, G Lopez Morteo, and F. Munoz-Arriola. Toward a Drought Seasonal Forecast in the Platte River Basin. *American Meteorological Society*, Phoenix, AZ. January 9th 2015. (poster)
- Castro-Garcia, L., G. Lopez-Morteo, and F. Munoz-Arriola. The Water for Food Interoperability System (WaFIS). *2015 Natural Resources Districts Legislative Conference*, Lincoln, NE. January 28, 2015. (poster)
- Munoz-Arriola, F., R. Stowell, C. Ancona-Villarreal, A. Rosales-Martinez, G. Lopez-Morteo, and D. Rudnick. Use of Interoperability/Information Systems to Inform Crop-, Cattle-, and Community-Decision Makers in a Changing Climate. *American Meteorological Society*, New Orleans, LA. January 14, 2016. (poster)
- Otte, M. and F. Munoz-Arriola. Representing Temperature and Precipitation Extremes by Dynamical Downscaling Using a Global, Multi-resolution Atmospheric Modeling System. *American Meteorological Society 30th Conference on Climate Variability and Change 2017*. Baltimore, US. July 28, 2017.

Publications: Livneh, B., T. Bohn, D. Pierce, F. Munoz-Arriola, B. Nijssen , R. Vose , D. Cayan, L. Brekke (2015): A spatially comprehensive, hydrometeorological data set for Mexico, the U.S., and southern Canada 1950-2013. *Nature - Scientific Data*, doi:10.1038/sdata.2015.42.

Additional Outputs (technological developments and transfers):

- Greer, H., S. Rehna, A. Kumar, M. Ou, and F. Munoz-Arriola. Editorial on Extreme events and climate change. *Lincoln Journal Star* (06/06/2017)

- Munoz-Arriola, F., L. Castro Garcia, and G. Lopez-Morteo (in progress). Water for Food Information System: From paper to Big Data. Funded by the Daugherty Water for Food Institute.
- Munoz-Arriola, F., A. Rosales, C.E. Ancona, and G. Lopez-Morteo (in progress). Water for Food Hydrological Seasonal Forecast System. Funded by the Daugherty Water for Food Institute and the Consejo Nacional de Ciencia y Tecnología-Mexico.
- Munoz-Arriola, F. and G. Lopez-Morteo. (1) Two data-collectors of data via web services programmed in Python and Java; (2) six APIs that standardize/translate/deliver data in multiple formats (CSV, JSON, netCDF, postgresSQL, SPSS, HDF and text); (3) three apps (2 for smart phone and webpage); (4) analytics to address crop, livestock, and community needs.

Changes in Knowledge: tbd

Changes in Action: tbd

- **Robert Oglesby**, Professor in Climate Modeling, Climate Change and Variability, UNL Earth & Atmospheric Sciences, for the project: *Leveraging DWFII Resources to Address Water for Agriculture in Latin America Under a Changing Climate*; Postdoctoral Fellow: **Rachindra Mawalagedara**

Robert Oglesby is the lead Primary Investigator on a series of projects aimed at providing high-resolution (4 km) spatial climate change downscaling information to Latin America from the present as projected 50 years into the future. This is the spatial scale needed by those in the individual countries concerned with the many and specific impacts that will result under a changing climate.

In each case, with local participation, Oglesby and his team make a series of state-of-the-art climate change downscaling simulations. These are then used by the participants for impact studies relevant to their own region and area of interest, and also serve as the basis for scientific publications. The goal is not just to provide climate change downscaling scenarios but instead instruct the local participants to both make and use these scenarios to address their key issues and problems. These projects are the nexus of research, teaching, service and outreach. Climate change will impact the availability of water for agriculture in this region, flooding frequency and intensity, and water quality.

Rachindra Mawalagedara served as an interface between Oglesby's existing and future work and the institute and built new relationships and directions. More specifically, she:

- Worked with the participants from the various Latin American countries to identify their specific climate impacts, vulnerability and adaptation needs, especially pertaining to water and food.
- Worked with the participants to make the most effective use of the climate change downscaling results .
- Integrated existing and future institute resources, personnel, and assets into all appropriate aspects of these Latin America projects.
- Educated Inter-American Development Bank (IDB) staff, individual country government ministries, and NGOs that were encountered during this work about the institute and its capabilities.

Mawalagedara performed all of her project functions in a superb manner. She handled most of the correspondence with consortium participants, who all spoke very highly of her. She supervised many of the analyses of the climate change downscaling simulations, as well as being an active participant in the preparation of the numerous internal reports and proceedings that resulted. **She is now a Lecturer for the Department of Geological and Atmospheric Sciences at Iowa State University.**

Presentations:

- R. Oglesby, C. Rowe and R. Mawalagedara. Climate Model Simulation of Present and Future Extreme Events in Latin America and the Caribbean: What Spatial Resolution is Required? *UNESCO COP21 Climate Change Summit*. France. July 2015.
- A. Abadi, R. Oglesby, R. Mawalagedara, and C. Rowe. Evaluation of GCMs Historical Simulations of Monthly and Seasonal Climatology over Bolivia. *American Geophysical Union*. San Francisco. December 2015.
- C. Rowe, R. Oglesby, R. Mawalagedara, and A. Abadi. Climate Model Simulation of Present and Future Extreme Events in Latin America and the Caribbean: What Spatial Resolution is Required? *American Geophysical Union*. San Francisco. December 2015.

Publications:

- Impacts of Deforestation on Temperature and Precipitation in South and Southeast Asia (In review)
- R. Mawalagedara and R. Oglesby. Using High Resolution (4 km) Downscaling from WRF to Project Future Changes in Mean Climate for Sri Lanka (in review)
- A. Abadi, R. Oglesby, R. Mawalagedara, and C. Rowe. Evaluating 21st Century Climate Change for Bolivia: A Comprehensive Dynamical Downscaling Strategy Using the WRF Regional Climate Model (in progress)
- Numerous project reports, workshop reports, and internal documents.

Changes in Knowledge:

- Provided training in climate change downscaling to the Honduras National University in Tegucigalpa, Honduras in August 2014.
- Provided country level training for Colombia in seasonal forecasting. The first workshop was held in July, 2015 in Bogota, Colombia with a follow-up planned. Also planning a similar workshop for Peru.
- Currently organizing country level training for Jamaica, Cuba, Hispaniola, Puerto Rico, the Windward and Leeward Islands, Trinidad and Tobago, Suriname, and Belize.
- Oglesby and Mawalagedara participated in *Observing & Modeling Climate Variability in the Intra-Americas Seas & Impacts on the Continental Americas & the Caribbean*, a CLIVAR Virtual Workshop held September 9-11, 2015.
- Oglesby and team held the “Program to Strengthen Institutional Capacity to better assess Climate Impacts in Latin America and the Caribbean (LAC),” Workshop 1: Initiation of the Regional Climate Change Consortium in Panama City, Panama in June 6-10, 2016.

Changes in Action:

- Oglesby and team secured funding for the Program to Strengthen Institutional Capacity to better assess Climate Impacts in Latin America and the Caribbean (LAC) from the IAB (2/6/16-12/31/17). Doing so involved developing connections with eleven countries to secure their commitment to the Regional Consortium for Climate Change for Latin America and the Caribbean. As noted above, we held the First Workshop for the Regional Consortium June 6-10 in Panama City at CATHALAC Headquarters (Water Center for the Humid Tropics of Latin America and the Caribbean). Ten countries attended. Four more workshops are planned between now and the end of 2017. Workshop 2 has been scheduled for November 14-18, 2016.
- Caribbean Initiative - Oglesby and team are organizing country level training for Jamaica, Cuba, Hispaniola, Puerto Rico, the Windward and Leeward Islands, Trinidad and Tobago, Suriname, and Belize. This is anticipated to be a companion project to the LAC regional consortium and include the making of new downscaling simulations with a focus on the Caribbean islands.

- Seasonal Climate Forecasting Initiative – This initiative started with the Colombia workshop held in July 2015. Oglesby and team are in discussions for follow-up work in Colombia and are also in discussions with the Ministry for the Environment of Peru for a similar Peruvian initiative.

Daugherty Graduate Research Assistantships – MS and Ph.D. positions

DWFI Faculty Fellows and DWFI Faculty Affiliates were invited to submit applications for assistantship support. Five assistantships were awarded to:

- **Carrick Detweiler**, Assistant Professor, UNL Computer Science and Engineering, for the project: *Enabling Sub-Surface Aerial Water Sampling for Water Management and Quality Analysis*
Masters Student: **James Higgins**, for an M.S. in Mechanical and Materials Engineering with a minor in Computer Science

Presentations: This work was presented in a variety of forums to engage community members, researchers, and practitioners. In addition to disseminating this work, these talks were used as opportunities to learn more about water sampling requirements from different groups. For example, when talking with faculty and students from the Ocean Engineering department at the University of Rhode Island, the team learned about the opportunity, need, and requirements for aerial water sampling of coastal wetlands, which is currently extremely challenging with existing techniques. The most relevant talks given were:

- Carrick Detweiler, “Using Drones for Water Sampling,” Talk at Nebraska Surface Water Monitoring Council Meeting. Lincoln, NE, October 2014.
- James Higgins, "Robotic Water Sampling and Sensing in the Wild," Poster at NRD Legislative Conference. Lincoln, NE, January, 2015.
- Carrick Detweiler, “Bringing Drones Down to the Water,” Talk at NRD Water Programs Conference. Kearney, NE, February, 2015.
- Carrick Detweiler, “Bringing Aerial Robots Closer to the Water: Sensing, Sampling, and Safety.” Talk at University of Rhode Island, Ocean Engineering Seminar Series. Kingston, Rhode Island, April, 2015.
- James Higgins, "Aerial Robotics: Innovation, Productivity and Fun," Talk at St. John High School. St. John, Kansas, May, 2015.
- James Higgins, "Unmanned Environmental Monitoring and Sample Collection," DWFI Research Forum. May, 2015.
- James Higgins, “Robotic Mechanisms for Water Sample and Data Collection,” DWFI Global Conference, Lincoln, NE. April, 2016.
- Carrick Detweiler, “Unmanned Environmental Monitoring and Sample Collection,” DWFI Research Forum. May, 2016.

Publications:

- A joint publication with UC Berkeley that examines the overall methodology and how it compares to traditional water sampling approaches.
M. Chung, C. Detweiler, M. Hamilton, J. Higgins, J.-P. Ore, S. Thompson. Obtaining the Thermal Structure of Lakes from the Air. *Journal Water*, 7, 6467-6482, 2015.
- A paper on the waterbug accepted to appear at the International Conference on Intelligent Robots and Systems, which is the top general robotics conference.
J. Higgins and C. Detweiler. “The Waterbug Sub-Surface Sampler: Design, Control and Analysis.” Accepted to Appear in the International Conference on Intelligent Robots and Systems (IROS). Daejeon, Korea. October, 2016.
- James Higgins’ MS thesis, which he successfully defended in July of 2016.

J. Higgins. "Design, Testing, and Evaluation of Robotic Mechanisms and Systems for Environmental Monitoring and Interaction." M.S. Thesis at the University of Nebraska-Lincoln. 2016.

Changes in Knowledge: James Higgins graduated in August 2016 with an M.S. in Mechanical and Materials Engineering and began working for a UAV (unmanned aerial vehicle) design company.

Changes in Action:

- This project resulted in the development of an unmanned aerial vehicle (UAV) that is able to obtain sub-surface water samples from remote locations with minimal effort by operators.
 - This technology enables scaling of water sampling to cover larger areas and/or higher resolution sampling at areas of interest.
 - Tests of the technology are ongoing with partners at the University of Kansas and the University of California-Berkeley to answer context-specific questions related to water management and quality that cannot be answered today due to the cost and spatiotemporal limitations of current sampling techniques.
 - The preliminary work conducted by James Higgins laid the groundwork for a nearly \$1 million U.S. Department of Agriculture grant (as part of the National Robotics Initiative) that began September of 2016 and targets sensing and sampling of wetlands environments. This grant involves another UNL Computer Science faculty member and a group of robotics and water scientists at the University of the Pacific in California.
- **Trenton Franz**, Assistant Professor of Hydrogeophysics, UNL School of Natural Resources, for the project: *Improving soil moisture monitoring in agricultural systems using hydrogeophysics*
Masters Student: **William Avery**, for an M.S. from UNL School of Natural Resources
- Presentations:**
- *Global Water for Food Conference*, Seattle, Washington, October 19-22, 2014. (poster)
 - *American Geophysical Union Conference*, San Francisco, California, December 15–19, 2014. Avery authored one poster and was listed as a co-author for two additional posters, one of which received an AGU Outstanding Student Presentation award.
 - School of Natural Resources Elevator Speech Contest
 - High Plains Aquifer: Sustainability for Food Production and Water Supply Symposium, March 19, 2015. (poster)
 - Nebraska Water Center Faculty and Partner Retreat, Kearney, October 7, 2015. (poster)
 - Nebraska Natural Resources Districts Legislative Conference, Lincoln, NE, January 27, 2016. (poster)
 - DWF Global Conference, Lincoln, NE, April, 2016. "The Cosmic-ray Neutron Soil Moisture Method: Applications for Large-Scale Precision Agriculture." (poster)
- Publications:**
- Franz, T. E., T. Wang, W. Avery, C. Finkenbinder, and L. Brocca (2015), Combined analysis of soil moisture measurements from roving and fixed cosmic ray neutron probes for multiscale real-time monitoring. *Geophys. Res. Lett.*, 42, 3389–3396.
(<http://onlinelibrary.wiley.com/doi/10.1002/2015GL063963/full>)
 - Avery, W. A., Finkenbinder, C., Franz, T. E., Wang, T., Nguy-Robertson, A. L., Suyker, A., Arkebauer, T., and Munoz-Arriola, F.: Incorporation of globally available datasets into the cosmic-ray neutron probe method for estimating field scale soil water content, *Hydrol. Earth Syst. Sci. Discuss.*, doi:10.5194/hess-2016-92, in review, 2016.
(<http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-92/>)

Changes in Knowledge:

- William Avery successfully completed an MS degree in Natural Resources after defending his thesis in May 2016 and graduated in August 2016. He spent six months in Vienna, Austria for an internship with the Food & Agriculture Organization of the United Nations and the International Atomic Energy Agency.
- William Avery was instrumental in helping set up ten stationary cosmic-ray neutron probes across the state at five different study sites near Mead, Waco, Grand Island, Sutton, and Brule. These five study sites have formed the basic infrastructure in Professor Franz's lab to host various undergraduate and graduate research projects for years to come. The lab is working with individual producers at the Waco (Romher Farms), Sutton (Paulman Farms), Brule (Armstrong Farms) study sites, and The Western Irrigation Project (The Nature Conservancy). The lab is working with the Eastern Nebraska Research and Extension Center at the Mead study site and West Center Research and Extension Center in North Platte (Daran Rudnick). At the Grand Island site, the team is working in conjunction with the Platte River Recovery Implementation Program through the Headwaters Corporation.
- In addition to setting the stationary probes, William Avery collected the majority of cosmic-ray rover surveys at the various study sites. Between 2014-2016 Avery completed 30 surveys at Waco, ten at Grand Island and Brule, and ten at Sutton.

Changes in Action:

- William Avery served as a key data collector and team leader helping manage the two undergraduate workers and other MS student.
- **Patricio Grassini**, Assistant Professor, UNL Agronomy & Horticulture, for the project: *Revealing the links between crop production, irrigation and inter-annual changes in groundwater levels in Nebraska* Masters Student: **Kate Gibson** (formerly Boone), UNL Agronomy & Horticulture

Presentations:

- Nebraska Natural Resources Districts Legislative Conference, Lincoln, NE, January 28, 2015.
- DWFI Student Support Research Forum, Lincoln, NE, May 28, 2015. "Impact of Irrigation on Local and Regional Groundwater Dynamics in Nebraska."
- Nebraska Water Center Faculty and Partner Retreat, Kearney, NE, October 7, 2015.
- Nebraska Natural Resources Districts Legislative Conference, Lincoln, NE, January 27, 2016.
- DWFI Global Conference, Lincoln, NE, April, 2016. "How much irrigation can be saved in Nebraska without hurting yields?"
- DWFI Research Forum, Lincoln, NE, May 12, 2016. "Benchmarking On-farm Irrigation Management in Nebraska."

Publications: Farmaha BS, Lobell DB, Boone K, Cassman KG, Yang, SH, Grassini P, 2016. Contribution of persistent factors to yield gaps in high-yield irrigated maize. *Field Crops Research* 186, 124-132.

Changes in Knowledge: Kate graduated in August 2016 and joined DWFI as a program associate working under the supervision of Nick Brozovic. She was recently promoted to research program manager.

Changes in Action: tbd

- **Alan Kolok**, Director, Center for Environmental Health and Toxicology, UNMC College of Public Health, and Professor, UNO Biology, for a project to study the pressure that agrichemicals exert on water resources; Ph.D. Student: **Jonathan Ali**, for a Ph.D. from the UNMC College of Public Health (Note: awarded subsequent funding as part of Round Three, match required)

Presentations and Posters (academic):

- DWFI Student Support Research Forum, Lincoln, NE, May 28, 2015. “Novel assessment tools: Utilizing citizen science and sentinel organisms to detect agrichemical runoff.”
- Ali J.M., et al. (Dec 2015) Nebraska Chapter of the American Fisheries Society Meeting-Streams and Rivers Technical Meeting, Gretna, NE, USA.
- Ali J.M., et al. (Nov 2015) Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting, Salt Lake City, UT, USA.
- Ali J.M, et al. (Apr 2016). Sustainability Launchpad: Accelerating Innovative Urban Ideas. Omaha, NE, USA. 1st Place Graduate Student Poster Competition.
- Ali J.M., et al. (Apr 2016). 2016 Water for Food Global Conference, Lincoln, NE, USA.
- DWFI Research Forum, Lincoln, NE, May 12, 2016. “Biomonitoring Watersheds in Nebraska and Chile: Advancing toxicity studies of agricultural runoff both near and far.”
- Ali J.M., et al. (Jan 2016). Natural Resource Department: Nebraska Natural Resources Commission Meeting. Lincoln, NE, USA.
- Ali J.M., et al. (Oct 2015). Nebraska Environmental Health Association 2015 Meeting, Ashland, NE, USA.
- Rakestraw M.J., et al. (Nov 2015). Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting. Salt Lake City, UT, USA.
- Kolok A.S., et al. (Nov 2015). Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting. Salt Lake City, UT, USA.
- Rakestraw M.J., et al. (Oct 2015). Nebraska Environmental Health Association 2015 Meeting, Ashland, NE, USA.
- Zhang Y., et al. (Jun 2015). Association of Environmental Engineering and Science Professors 2015 Research and Education Conference. New Haven, CT, USA.
- Ali JM and Kolok AS (2014). Society of Environmental Toxicology and Chemistry 2014 North America Annual Meeting, Vancouver, BC. “Pesticide runoff in the Elkhorn River, Nebraska, USA: Temporal variation in chemical occurrence and biological impact.” (poster)
- Ali JM, Lieurance DM, and Cipollini D (2013). Florida Exotic Pest Plant Council 2013 Annual Meeting, Panama City, FL. “Effects of soil biota and rhizosphere extract from non-native *L. maackii* on the native *L. capensis*.” (poster)

Presentations (community engagement):

- Apr 2015, Nebraska SciFest, University of Nebraska at Omaha, Omaha, NE. “Nebraska Science Fest: Testing the Waters”
- Feb 2015, Nebraska Watershed Network, Wahoo High School, Wahoo, NE. “What’s in Your Watershed”
- Nov 2014, Nebraska Watershed Network, Barbara Weitz Community Engagement Center, Omaha, NE. “What’s in Your Watershed”
- Oct 2014, University of Nebraska Medical Center High School Alliance, Barbara Weitz Community Engagement Center, Omaha, NE. “Environmental Health Science”

Publications:

- Ali J.M., Farhat Y.A. and A.S. Kolok. (2016) *Bulletin of Environmental Contamination and Toxicology*, 96(4):432-7.
- Ali JM and AS Kolok. (2015). On-site, serial exposure of female fathead minnows to the Elkhorn River, NE, USA spring agrichemical pulse. *Environmental Toxicology and Chemistry*, doi: 10.1002/etc.2928

- Ali J.M., Herrmann K.M.K., Rakestraw M.J. and A.S. Kolok. (2016) Citizen-based scientific data collection: Fact or fiction? *Integrated Environmental Assessment and Management*, 12(2), 400-402.
- Sangster J.L., Ali J.M., Snow D.D., Kolok A.S. and S.L. Bartelt-Hunt. Bioavailability and fate of sediment-associated progesterone in aquatic systems. *Environmental Science and Technology*, 50(7), 4027–4036.
- Zhang Y., Krysl R.G., Ali J.M., Snow D.D., Kolok A.S. and S.L. Bartelt-Hunt. (2015) *Environmental Science and Technology*, 49(15), 9037–9047.
- Ali J.M. Biomonitoring Watersheds in Nebraska and Chile. Manuscript in preparation.

Other Publications:

- Jurcsisn JG, Pye RL, Ali JM, Barr BL and CN Wyatt. (2015). The CamKK β inhibitor STO609 causes artifacts in Ca²⁺ imaging and inhibits BKCa in mouse carotid body type I cells. *Advances in Experimental Medicine and Biology*. (accepted)
- Ali JM, Lieurance DM, and D Cipollini. (2015). Soil biota affect mycorrhizal infection and growth of *Impatiens capensis* and alter the allelopathic effects of *Lonicera maackii*. *Journal of the Torrey Botanical Society*, 142(1), 1-11.

Changes in Knowledge: See Round Three

Changes in Action: See Round Three

- **Harkamal Walia**, Assistant Professor, UNL Agronomy & Horticulture, for the project: *Improving drought tolerance of wheat through more adaptive roots*; Ph.D. Student: **Sarah Blecha**, UNL Agronomy & Horticulture

Presentations:

2014 – Plant and Animal Genome Meeting, San Diego; Nexus: Water, Food, Climate and Energy Conference, Chapel Hill; University of California, Riverside; Gordon Research Conference for Salt and Water Stress in Plants, Maine

2015 – Colorado State University, Fort Collins

- Nebraska Natural Resources Districts Legislative Conference, Lincoln, NE, January 28, 2015.
- Nebraska Natural Resources Districts Legislative Conference, Lincoln, NE, January 27, 2016.
- DWFI Global Conference, Lincoln, NE, April, 2016. “Physiological and Genetic Investigation of Spring Wheat cv. Pavon Under Limited-Water Condition”

Publications: Geng B, Blecha S, Yufeng G, Walia H, Phansak P. Characterizing Wheat Response to Water Limitation Using Multispectral and Thermal Imaging. 2016, *American Society of Agricultural and Biological Engineers* (in review)

Changes in Knowledge: These multidisciplinary experiments will develop a more robust and flexible phenotyping platform and gain a temporal high-resolution characterization of drought stress responses for wheat genotypes, which differ in drought tolerance. Experiments include the transgenic wheat lines for drought tolerance. Sarah Blecha entered the Doctor of Plant Health Program in December 2016.

Changes in Action: This research generated new data that justified the filing of a non-provisional, full patent application for a gene that is involved in regulating root biomass under drought stress (filed in Nov., 2014 by UNL).

Daugherty Undergraduate Scholars

DWFI Faculty Fellows and DWFI Faculty Affiliates were invited to submit applications for undergraduate research assistantship support. Support for six students (to be hired post-award) was awarded to:

- **Vijendra Boken**, Associate Professor, UNK Geography and Earth Science, for a project to study the link between soil moisture estimates and global warming for Nebraska using satellite data.
Students: **Areeb Hossain, Ben Wagner, Emily Kaslon, Spencer Sydow, Tayler McPeak**
Presentations:
 - Hossain, Areeb S. and Boken, V. Sociology, Geography & Earth Science, University of Nebraska at Kearney. *Examining the Impact of Irrigation on Temperatures in Nebraska Counties.*
 - McPeak, T. and Boken, V. (2015) Assessing impact of irrigation on global warming. *International Conference on Climate Impacts and Responses*, Vancouver, BC, 10-11 April 2015.**Changes in Knowledge:** Tayler McPeak graduated in May 2016 and Emily Kaslon in May 2016.
Changes in Action: tbd

- **Michael Farrell and Mike Forsberg**, Assistant Professors of Practice, UNL Agricultural Leadership, Education and Communication, for the Platte Basin Timelapse Project. Students: **Merika Andrade, Joe Arneson, Grace Bullington, Ethan Freese, Carlee Koehler, Mariah Lundgren, Alex Lundvall, Zoe Mays, Grant Reiner, Andrew Wentz**
(Note: awarded subsequent funding as part of Round Four, match required)
Presentations: Key to this Platte Basin Timelapse Project's success so far has been recruiting and training a pool of emerging talented young people through paid internships.
 - *Global Water for Food Conference*, Seattle, Washington, October 19-22, 2014 (poster)
 - DWF Student Support Research Forum, Lincoln, NE, May 28, 2015.
 - Sunday with a Scientist, Lincoln, NE, June 12, 2016.
 - Timelapse videos available at: <http://plattebasintimelapse.com/>**Changes in Knowledge:** Mariah Lundgren graduated December 2014 and is now working part-time for the project supervising interns. Joe Arneson graduated May 2015. (additional reporting, Round Four)
Changes in Action: The project has established funding relationships with the Nebraska Corn and Soybean Boards and several others. (additional reporting, Round Four)

- **Julie Shaffer**, Professor, UNK Biology, to characterize abiotic and biotic components of lakes in the Willow Creek drainage of Brown County, Nebraska. Students: **Alyssa Dillon, Seth Springer**
Presentations:
 - Dillon, A., Shaffer, J., Peterson, B.C., Koupal, K.D., and Graham, K. (2015) Influence of common carp (*Cyprinus carpio*) on abiotic and biotic parameters within Nebraska's Sandhill lakes. Nebraska American Fisheries Society Meeting, Nebraska City, NE. *poster presentation*
 - Dillon, Alyssa, and Shaffer, Julie. (2015) Investigation of abiotic and biotic parameters in three Nebraska's Sandhill lakes within the same drainage. 17th Annual University of Nebraska at Kearney Student Research Day, Kearney, NE. *poster presentation*
 - Dillon, A. (2015) Influence of common carp (*Cyprinus carpio*) on abiotic and biotic parameters within Nebraska's Sandhill lakes. UNK Biology Senior Research Project. *oral presentation*
 - Shaffer, Julie (May, 2015) Nebraska sandhills lakes. Nebraska Department of Environmental Quality Annual Meeting (invited presentation), Kearney, NE. *oral presentation***Changes in Knowledge:** Two UNK undergraduate students conducted field research – Alyssa Dillon and Seth Springer.
Changes in Action: tbd

Round Two

In 2015 graduate student support was provided to faculty who were selected following a call for proposals. Faculty Fellows secured additional funds on their own to support the students, matching DWFI funds one-to-one. By FY19 support continues for one of the seven graduate students originally awarded support.

Daugherty Graduate Research Awards – MS and Ph.D. positions

DWFI Faculty Fellows were invited to submit applications for student support up to \$16,000, with additional student funding secured by the Faculty Fellow. Seven assistantships were awarded to:

- **Shannon Bartelt-Hunt**, Associate Professor, UNL Civil Engineering, for a project to evaluate the direct effects of climate and the indirect effects of climate-induced animal agriculture clustering on the fate of trace organic compounds originating from production agriculture. Ph.D. Student: **Renys Barrios**, for a Ph.D. in Environmental Engineering
Over the grant period, we have completed large scale column studies of atrazine transport in soils collected from our study site and have initiated large scale column studies for antibiotic transport and to evaluate changes in microbial community structures. We hosted one WARI intern: Omkar Goankar and one undergraduate student researcher, Claire Devereaux, who participated in the research activities of this project. This work has been highlighted in numerous media outlets including the American Society of Civil Engineers magazine and Nebraska Education Television (NET). In 2018 we presented the results of this research to a groundwater planning and management organization in the state of Minnesota and the Water for Food Research Forum, April 26, 2018.

Presentations and Publications:

- Barrios, R.; Gaonkar, O.; Snow, D.D.; Li, Y.; Bartelt-Hunt, S.L.; Li, X. Enhanced Biodegradation of atrazine at high infiltration rates in agricultural soils. (in preparation for submission in July 2018).
- Barrios, R.; Akbariyeh, S.; Gani, K.M.; Kovalchuk, M.T.; Park, J.; Li, X.; Li, Y.; Thompson, E.; Rosenbaum, D.; Snow, D.; Tang, Z.; Gates, J.; Bartelt-Hunt, S.L. Climate change impacts the subsurface transport of trace organics originating from agricultural production activities. *Climate Dynamics* (in review).
- Barrios, R.; Gaonkar, O.; Bartelt-Hunt, S.L.; Li, X.; Snow, D.D.; Li, Y. (2018). Influence of climate change on subsurface atrazine degradation and transport. American Chemical Society Spring Meeting, New Orleans, LA, March 18-21, 2018.
- Bartelt-Hunt, S.L. and Thompson, E. (2017). The influence of agricultural clusters on groundwater quality under climate change. Nebraska Water Symposium, Lincoln, NE October 26-27, 2017.
- Barrios, R.; Bartelt-Hunt, S.L.; Li, X.; Li, Y.; Zhang, Y.; Gani, K.M. (2017). Influence of Climate Change on Trace Organic Fate in the Subsurface. AEESP Research and Education Conference, Ann Arbor, MI June 21-23, 2017.
- Barrios, R.; Akbariyeh, S.; Bartelt-Hunt, S.L.; Li, Y.; Li, X.; Snow, D.D.; Tang, Z.; Rosenbaum, D.; Park, J.; Thompson, E. (2017). Groundwater quality, trace organic fate and climate change (in preparation for submission in August 2017).

- Akbariyeh, S.; Bartelt-Hunt, S.L.; Snow, D.D.; Li, X.; Tang, Z.; and Li, Y. Numerical modeling of nitrate leaching: Interaction of groundwater vertical flux and infiltration of nitrate in a 3-D soil profile. *Vadose Zone Journal*, (in review).
- Akbariyeh, S., Wang, T., Bartelt-Hunt, SL, Li, Y. (2016). Application of Inverse Modeling to Estimate Groundwater Recharge under Future Climate Scenarios. American Geophysical Union Fall Meeting, San Francisco, CA, December 12-16, 2016.
- Barrios, R. (2016). Influence of Climate Change on Trace Organic Loading Rates to Groundwater. DWFI Research Forum, Lincoln, NE, May 12, 2016.
- Akbariyeh, S., Snow, D., Bartelt-Hunt S.L., Li, X., and Li, Y. (2016). Three dimensional modeling of agricultural contamination of groundwater: a case study in the Nebraska Management Systems Evaluation Area (MSEA). Water, Sustainability and Climate Investigator’s Meeting, Washington D.C., March 9-11, 2016.
- Bartelt-Hunt, S.L. and Thompson, E. (2016). Influence of climate on the fate of trace organics in groundwater. Water, Sustainability and Climate Investigator’s Meeting, Washington D.C., March 9-11, 2016.
- Akbariyeh, S., Snow, D., Bartelt-Hunt S.L., Li, X., and Li, Y. (2015). Three dimensional modeling of agricultural contamination of groundwater: a case study in the Nebraska Management Systems Evaluation Area (MSEA). American Geophysical Union Fall Meeting, San Francisco, CA, December 14-18, 2015.
- Bartelt-Hunt-S.L. (2015) The effect of climate on the fate of trace organics in groundwater. Groundwater Foundation National Meeting, Lincoln, NE, Oct. 21-22, 2015.

- **Junke Guo**, Associate Professor, UNL Civil Engineering, for the project: *Determinaton of River Ecological Discharge from Navier-Stokes-Forchheimer Equation*. Ph.D. Student: **Narendra Kumar Patel**, for a Ph.D. in Civil Engineering (specializing in Hydraulics and Water Resources) **As of May 2018, Narendra Kumar Patel continues his research by collecting data, analyzing data, and writing reports. (One year he did now draw down his award, thus it carried over.)**

The recent research based on the Navier-Stokes-Forchheimer equation is listed below. Research on “flow between parallel disks” and “river flow with vegetation bed” makes sure that we have an understanding of the methodology and our current research work will be successful by producing deliverable results. The first reference below provides an exact analytical solution for vegetated flow and is mostly related to the proposed research work; the second solves a similar problem to the proposed research.

- Guo, J., Zhang, J. (2016). Velocity distribution in laminar and turbulent vegetated flows. *Journal of Hydraulic Research*.
- Guo, J. (2015). Exact solution to Navier-Stokes equation for radial flow between parallel disks. *Journal of Hydraulic Research*.

Presentations: 2016 Water for Food Global Conference (poster); Water for Food Institute Research Forum, May 12, 2016, UNL; Water for Food Research Forum, April 26, 2018. Narendra Patel also presented his research at the 8th International Symposium on Environmental Hydraulics, held June 4-7, 2018 at the University of Notre Dame, Indiana, USA.

Changes in Knowledge: This research helped determine the percentage of water flowing below the river bed. This is the additional water which should be released from a dam to maintain the ecosystem on the downstream side. The study also helps water managers know the water loss in natural channels with porous beds.

- **Adam Liska**, Associate Professor, George Dempster Smith Chair of Industrial Ecology, UNL Biological Systems Engineering and Agronomy & Horticulture, for the project: *Climate Change Feedbacks via Insurance*. Masters Student: **Eric Holley**, for an M.S. in Natural Resource Sciences (Human Dimensions Emphasis) from UNL School of Natural Resources.
Presentations: DWFI Research Forum, Lincoln, NE, May 12, 2016. “Climate Change Feedbacks via Insurance.”
Publications:
Eric R. Holley, Adam J. Liska, Michael Hayes, Max Ruldoph, Geoffrey C. Friesen, Donald E. Wilhite, “Climate Change Feedbacks Via Insurance,” in process, to be submitted to *Nature Climate Change* or *Climate Change*, if needed
Adam J. Liska, Tyler R. White, Eric R. Holley & Robert J. Oglesby (2017) Nuclear Weapons in a Changing Climate: Probability, Increasing Risks, and Perception, *Environment: Science and Policy for Sustainable Development*, 59:4, 22-33, DOI: 10.1080/00139157.2017.1325300
Changes in Knowledge: Eric Holley graduated in August 2016 and is pursuing a Ph.D. in the same program. His research has evolved to focus on an investigation of the climate and agricultural risks associated with nuclear energy. “These problems have very broad negative implications for agriculture, and we hope to lead new research into these issues with partners at the National Strategic Research Institute at the University of Nebraska.”

- **Patrice McMahon**, Associate Professor, UNL Political Science, for the project: *Transnational Actors and Water Security*. Ph.D. Student: **Maria Benes**, for a Ph.D. in Political Science (specializing in Comparative Politics and International Relations)
Presentations:
 - Benes, M. “Water from the Spider’s Web: A Review of the Literature on Transnational Networks and Water Security,” International Studies Association Midwest Conference, St. Louis, MO, November 20-22, 2015
 - McMahon, P. Krakow, Poland: Cooperation Rules: Insights on Water and Conflict from International Relations” Interdisciplinary Conference on New Security Issues, June 2016
 - McMahon, P. and Benes, M., “New Partnerships in Water Security,” at World Conference on Humanitarian Studies, Addis Abba, Ethiopia, March 2016
 - McMahon, P and Benes, M. invited talk, “Moving Beyond Borders: Transnational Actors, Networks and Water Security,” Water Centric Cities Conference, University of Wisconsin-Milwaukee, April 2016
 - Benes, M. and McMahon, P. “Moving Beyond Borders: Transnational Actors, Networks and Water Security, Water for Food Institute Research Forum, University of Nebraska-Lincoln, May 12, 2016
 - McMahon, P, “Ethiopia: International Actors and Lessons Learned,” panel organizer and panelist, DWFI Global Conference, Lincoln, April 10, 2017.
 - McMahon, P, “The NGO Game: Nongovernmental Organizations in Post-Conflict Peacebuilding and Water Security” Hebrew University, Jerusalem, Israel. May 2017
 - Benes, M. “Moving Beyond Borders: Transnational Actors, Networks and Water Security,” DWFI Research Forum, Lincoln, NE, May 11, 2017.
 - Benes, M. “Water from the Spider’s Web: Has the UN-Water Network Met Its Goals?,” Midwest Political Science Association Conferences, Chicago, IL, April 2018
 - Benes, M. “Global Water Strategy: Assessing the First 15 Years of UN-Water,” NU Robert B. Daugherty Water for Food Institute Research Forum, University of Nebraska-Lincoln, April 2018

Publications:

- McMahon, P. "Cooperation Rules: Insights on Water and Conflict from International Relations," in *Water Security and Peacebuilding in the Middle East*, edited by Jean Cahan Forthcoming: Anthem Press.
- Benes, M. "The Many Faces of 'Water Security: Diffusion of Water Security Norms Within the UN-Water Network,'" preparing this paper for potential publication
- Benes, M. and McMahon, P, "An Ethnographic Case Study of the Ethiopian Water Security Network"

Changes in Knowledge:

- Benes visited Addis Abba, Ethiopia to do background research and interviews with international and local NGOs, foundations and international organizations working on water security. McMahon and Benes worked separately, together and with an international group from Ethiopia on grants, publications, and presentations related to water security and water networks.
- Organized monthly interdisciplinary meetings on human security and water with faculty and graduate students in the Political Science Department (Fall 2015).

Changes in Action:

- McMahon, P., Shank, N, Beyene, Z, Beyene, S, Benes, M., Women's Empowerment Network, submitted a grant to USAID, June 2016.
- Benes was invited to join the DWFI policy team to collaborate on a water security and entrepreneurship project that focuses on networks and grassroots coalitions in the High Plains region.

- **Mehmet C. Vuran**, Associate Professor, UNL Computer Science and Engineering, for the project: *Taking Soil to the Cloud: Advanced Wireless Underground Sensor Networks for Real-time Precision Agriculture*. Ph.D. Student: **Abdul Salam**, for a Ph.D. in Computer Engineering
Presentations: Salam. DWFI Research Forum, Lincoln, NE, May 12, 2016. "Taking Soil to the Cloud: Advanced Wireless Underground Sensor Networks for Real-time Precision Agriculture." Water for Food Research Forum, April 26, 2018.

Publications:

- M. C. Vuran, **A. Salam**, R. Wong, and S. Irmak "Internet of Underground Things in Precision Agriculture: Architecture and Technology Aspects", under review in *Ad Hoc Networks* (Elsevier), Aug 2018.
- **A. Salam**, M. C. Vuran, "Wireless Underground Channel Diversity Reception With Multiple Antennas for Internet of Underground Things", in *Proc. of the IEEE ICC 2017*, Paris, France, May 2017.
- **A. Salam**, M.C. Vuran, and S. Irmak, "Pulses in the Sand: Impulse Response Analysis of Wireless Un-derground Channel", in *Proc. of the 35th IEEE International Conference on Computer Communications (IEEE INFOCOM 2016)*, April 2016, San Francisco, CA, USA.
- **A. Salam** and M.C. Vuran, "Impacts of Soil Type and Moisture on the Capacity of Multi-Carrier Modulation in Internet of Underground Things", to appear in *Proc. of the 25th International Conference on Computer Communication and Networks (ICCCN 2016)*, August 2016, Waikoloa, Hawaii, USA. **The paper received the Best Student Paper award at ICCCN 2016.**

Changes in Knowledge: During his research, Abdul Salam has developed the first cognitive radio-enabled wireless underground communication testbed in South Central Agriculture Lab, Clay Center,

NE. This testbed has been used to analyze software-defined communication solutions using cognitive radios in underground settings. This testbed has been utilized to develop advanced underground communication techniques during this project.

Changes in Action: Abdul Salam earned his Ph.D. and joined Purdue as an Assistant Professor (Fall 2018).

- **Wayne Woldt**, Associate Professor, UNL Biological Systems Engineering, for the project: *Improving Variable Rate Irrigation Efficiency using a Real-time Soil Moisture Adaptive Control Model Informed by Sensors Deployed on Unmanned Aircraft*

Masters Student: **Mitch Maguire**, for an M.S. in Biological Systems Engineering (funding awarded in 2015, student brought on board in 2016)

Variance in project plan: One of the variances the project team encountered is the use of a dual sensor system, rather than a triple sensor system. We experimented with the multi-spectral sensor and were able to combine the red, green and blue bands to achieve an adequate representation of an optical image. Thus, the team was able to eliminate the optical sensor and the associated weight and space requirements in the payload area of the aircraft. Another variance was a modification to the FAA issued Certificate of Authorization that extends the ceiling, or maximum altitude, of the unmanned aircraft from a height of 400 feet AGL up to 1199 feet AGL. This allows the project team to fly missions quicker and also aids synthesis of the images.

Presentations:

- Mitch Maguire, *Improving Variable Rate Irrigation Efficiency Using a Real-time Soil Moisture Adaptive Control Model Informed by Sensors Deployed on Unmanned Aircraft*, Water for Food Research Forum, April 26, 2018.
- Mitch Maguire, Burdette Barker, Christopher Neale, Wayne Woldt, *Modeling Evapotranspiration using Multispectral and Thermal Infrared Imagery Acquired with a Low Altitude Unmanned Aerial System*, 2018 Remote Sensing and Hydrology Symposium
- Mitch Maguire, Burdette Barker, Christopher Neale, Wayne Woldt, Andy Suyker, *Modeling Evapotranspiration using Multispectral and Thermal Infrared Imagery Acquired with a Low Altitude Unmanned Aerial System*, 2018 ASABE Annual International Conference
- Wayne Woldt, Christopher Neale, Derek Heeren, Eric Frew, George Meyer, *Improving Agricultural Water Efficiency with Unmanned Aircraft*, 2018 AUVSI Xponential Unmanned Aircraft Conference
- Mitch Maguire, Wayne Woldt, Christopher Neale, *A Production Field Scale Review of Agricultural Image Processing and Dual Sensor Integration for Unmanned Aircraft Systems (poster)*, 2017 DWFI Water for Food Global Conference
- Mitch Maguire, *Improving Variable Rate Irrigation Efficiency Using a Real-time Soil Moisture Adaptive Control Model Informed by Sensors Deployed on Unmanned Aircraft*, DWFI Research Forum, Lincoln, NE, May 11, 2017.
- Mitch Maguire, Wayne Woldt, Christopher Neale, George Meyer, Eric Frew, *A Survey of Agricultural Image Processing for Unmanned Aircraft Systems (paper)*, 2017 ASABE Annual International Conference
- Mitch Maguire, Wayne Woldt, Jacob Smith, Jack Elston, Eric Frew, *Thermal and Multi-Spectral Dual Sensor Integration for Unmanned Aircraft Systems (paper)*, 2017 ASABE Annual International Conference

Changes in Knowledge: As part of this project, an Extension workshop entitled “*Flight to Maps*” was developed and delivered in which participants learned about unmanned aircraft, auto-pilot systems,

sensors, and data processing. The workshop was delivered at the UNL Eastern Nebraska Research and Extension Center on April 23, 2018, with 15 participants spanning 5 states.

Mitch Maguire earned his Master's degree in August 2018 and is continuing his research to earn his Ph.D. degree, based on the support of a USDA grant (briefly described below).

Change in Condition: This student support was critical in securing a USDA AFRI grant of nearly \$500,000 based on the research that has been pursued under this project. Now this research may be expanded in very significant directions.

- **Haishun Yang**, Associate Professor and Crop Simulation Modeler, UNL Agronomy and Horticulture, for the project: *Determination of field sensor density for real-time crop management*
Masters Student: **Babak Samani**, for an M.S. from UNL Computer Science & Engineering
Presentations: DWFRI Research Forum, Lincoln, NE, May 12, 2016. "Determination of Field Sensor Density for Real-time Crop Management."
Change in Knowledge: In this project, we designed and developed a new visualization system to display the risk of nitrogen leaching in corn fields in the state of Nebraska – Maize-N (<https://hybridmaize.unl.edu/Maize-N>). This system is accessible from anywhere by most mobile devices on any platform. The system takes three sets of data, including weather data, soil texture data, and field data, and computes the risk of N leaching and visualize this risk to the users. Users, especially producers and researchers, can explore and discover the risk of N leaching for different locations in different styles such as heat-map and colored polygons. We integrated heterogeneous datasets into the system to help producers and domain scientists establish the connection between different input parameters of the system which cause different amount of nitrogen leaching. Several experiments with real-world weather data and user inputs demonstrate the effectiveness of the system. To give this confidence to users to use the application, we applied several levels of security to the system. In addition, to maximize the performance of the application, several back-end services have been applied to the system.

Future work

Although the main functionality of the application has been achieved in this project, some parts of the application still need to be improved and other features can be added to the application in the future. For instance, having a visualization to illustrate uncertainty of N leaching for different locations would be very beneficial to researchers and students to have better vision and understanding about effect of other parameters on N leaching. Another improvement that can be applied to this project is to add soil data and cropland data of other states to the system and expand the application so that producers and researchers from other states can use the application easily. For future work, applying several technical tests such as penetration test for improving the security of the application can be beneficial. User experience study or UX is another test for improving the application and making the application more user friendly.

Round Three

In 2016 eleven awards were given to support graduate student research. Faculty Fellows secured additional funds on their own to support the students, matching DWFI funds one-to-one. **By FY19 support continues for six of the eleven students originally awarded support.**

Daugherty Graduate Research Awards – MS and Ph.D. positions

DWFI Faculty Fellows were invited to submit applications for student support up to \$16,500, with additional student funding secured by the Faculty Fellow. Student support was awarded to:

- **P. Stephen Baenziger**, Professor, UNL Agronomy and Horticulture, for the project: *Agronomic and Genomic Evaluation of Winter Wheat for Hybrid Seed Breeding*; Ph.D. Student: **Amanda Easterly**, for a Ph.D. in Agronomy (Plant Breeding and Genetics Emphasis)

Presentations:

- International Annual Meeting of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, Phoenix, Arizona, November 2016.
- International Wheat Yield Partnership Grant Meeting at the Plant and Animal Genome Conference, January 2017.
- Water for Food Global Conference, April 2017.
- UNL Spring Research Fair, April 2017.
- Conference for Applied Statistics in Agriculture, Manhattan, KS, April 2017.
- DWFI Research Forum, May 11, 2017.

Publications: The results of this work are currently being used to prepare a manuscript for submission during the summer of 2017.

Changes in Knowledge: In 2016 she passed her comprehensive examinations, achieved Ph.D. candidacy and added a minor in Statistics to her program of study. Steve Baenziger opted to forgo additional support for Easterly; instead he submitted a proposal for another graduate student who was awarded funding in Round Four. **Easterly successfully defended her thesis and earned her Ph.D. December 2018. She is the first student to graduate from the hybrid wheat program.**

Changes in Action: See Round Four – Nicholas Garst.

- **Guillermo Baigorria**, Assistant Professor, UNL School of Natural Resources and Agronomy and Horticulture, for the project: *Climate change impacts assessment on water requirements and yields on corn, soybean and wheat in the USA*; Ph.D. Student: **Amit Timilsina**, for a Ph.D. in Natural Resource Sciences (specializing in Climate Assessment and Impacts)
Data and software provided by Next Season Systems LLC. Data and software were provided under a non-profit agreement for the exclusive use of Amit's thesis research.

Presentations:

- Water for Food Global Conference, April 2017 (poster)
- DWFI Research Forum, May 11, 2017

Publications: Amit Timilsina's dissertation thesis was completed July 2017.

Changes in Knowledge: Amit Timilsina earned his Ph.D. and graduated August 2017.

The information generated has a lot of value in terms of projecting crop yield, water requirements and water efficiency in two of the most economically important crops in the USA – corn and soybean. By knowing the projected water requirement under climate change at high resolution, we can plan for how many more years we can continue applying irrigation from groundwater sources,

to be able to plan a better use of water in the future, and to begin testing different adaptation practices such as changing planting dates, use of new varieties, or even changing to more water efficient crops in certain regions.

- **Yulie Meneses**, Post-doctoral Research Associate, and **Jayne Stratton**, Research Associate Professor, UNL Food Science and Technology, for the project: *Reconditioning and reuse of processing wastewater. An application for the grain wet milling industry*; Ph.D. Student: **Xinjuan Hu**, for a Ph.D. in Food Science and Technology

To date organic pollutants in meat processing wastewater were efficiently removed and transferred into valuable products. However, additional work still needs to be done to treat heavily polluted food processing wastewater to achieve direct discharge level; to apply it on large scale; as well as to process the microalgae biomass into a valuable commercial product. Therefore, in the future, the following steps will be conducted to reach this final objective: 1) study the effect of different wastewater pretreatments on the removal of pollutants and biomass/lipid accumulation; 2) study the performance of microalgae encapsulated in alginate-beads on pollutant removal efficiency and microalgae harvesting; 3) analysis of microalgae composition and processing of microalgae biomass; and 4) cost evaluation for microalgae-based treatment for food processing wastewater.

Presentations: DWFI Research Forums, May 11, 2017; April 26, 2018.

Publications: A proposal for the Alliance for Advanced Food Sanitation, where she proposed to use enzymes as a pretreatment for apple processing wastewater to improve the efficiency of membrane filtration treatment.

Changes in Knowledge: tbd

Changes in Action: tbd

- **Cory Forbes**, Associate Professor, UNL School of Natural Resources, and Coordinator, Science Literacy Initiative, for the project: *Fostering Undergraduate Students' Disciplinary Learning and Water Literacy*. Ph.D. Student: **Destini Pettitt**, for a MS in Natural Resource Sciences with an emphasis on Science Literacy

Conference Attendance and Research Outputs:

- **Pettitt, D.**, Lally, D., Forbes, C.T., Brozovic, N., & Franz, T. *Transdisciplinary Undergraduate Students' Learning and Reasoning about Socio-hydrological Issues*. Poster accepted to the 2018 Earth Educators Rendezvous Meeting (EER), Lawrence, KS.
- **Pettitt, D.** *A comparative study of the role of values in reasoning about socio-hydrological issues in undergraduate students from developed and developing countries*. Research presented at the 2018 Daugherty Water for Food Institute (DWFI) research forum, Lincoln, NE.
- Forbes, C.T., Brozović, N., Franz, T., Lally, D., & **Pettitt, D.** "Water in Society: An Interdisciplinary Course to Support Undergraduate Students' Water Literacy". Article accepted to the Journal of College Science Teaching (JCST) 2017.
- **Pettitt, D.**, Lally, D., Forbes, C.T., Brozovic, N., & Franz, T. *Transdisciplinary Undergraduate Students' Learning and Reasoning about Socio-hydrological Issues*. Poster presented at the 2018 meeting of the National Association of Research in Science Teaching (NARST), Atlanta, GA.
- **Pettitt, D.**, Lally, D., Forbes, C.T., Brozovic, N., & Franz, T. *Transdisciplinary Undergraduate Students' Learning and Reasoning about Socio-hydrological Issues*. Poster presented at the 2017 meeting of the Geological Society of America Conference (GSA), Seattle, WA.

- Lally, D., **Petitt, D.**, Forbes, C.T., Brozović, N., & Franz, T. *Water in Society: Interdisciplinary Undergraduate Teaching and Learning about Water*. Research presented at the 2017 meeting of the Earth Educators Rendezvous, Albuquerque, NM.
- Forbes, C.T., Brozović, N., Franz, T., Lally, D., & **Petitt, D.** *Transdisciplinary Undergraduate Water Education: Pedagogical Reflections*. Research presented at the 2017 meeting of the North American Colleges and Teachers of Agriculture Conference (NACTA), Purdue University, West Lafayette, IN.
- **Petitt, D.** *A comparative study of the role of values in reasoning about socio-hydrological issues in undergraduate students from developed and developing countries*. Research presented at the 2017 Daugherty Water for Food Institute (DWFI) research forum, Lincoln, NE.
- Forbes, C.T., Brozović, N., Franz, T., Lally, D., & **Petitt, D.** *Fostering undergraduate students' disciplinary learning and science literacy*. Poster presented at the 2017 meeting of the Water for Food Global Conference, Lincoln, NE.
- Forbes, C.T., Brozović, N., Franz, T., Lally, D., & **Petitt, D.** *Fostering undergraduate students' disciplinary learning and science literacy*. Poster presented at the 2016 meeting of the Geological Society of America (GSA), Denver, CO.
- Forbes, C.T., Brozović, N., Franz, T., Lally, D., & **Petitt, D.** *Fostering undergraduate students' disciplinary learning and science literacy*. Poster presented at the 2016 meeting of the Nebraska Water Center Symposium and Water Law Conference, Lincoln, NE.
- Forbes, C.T., Brozović, N., Franz, T., Lally, D., & **Petitt, D.** *Fostering undergraduate students' disciplinary learning and science literacy*. Poster presented at the 2016 meeting of the STEM Education Retreat, Lincoln, NE.

Results and assessment of projects from inception to date

- Research in *SCIL 101 "Water and Decision-making for a complex world"* – Completed
 - This class was designed to help students become scientifically-informed decision-makers. While the class focused on various socio-scientific issues, Destini's research in this class focused on how students use their values in reasoning about complex socio-hydrological issues.
 - Thesis "A comparative study of the role of values in reasoning about socio-hydrological issues in undergraduate students from developed and developing countries"

Changes in Knowledge: Destini Petitt graduated Spring 2018. Project is heading into its third year and has served over 100 students from both STEM and non-STEM departments

- **Trenton Franz**, Assistant Professor of Hydrogeophysics, UNL School of Natural Resources, for the project: *Observed and modeled quantification of reduced pumping volumes using advanced irrigation technologies in Western Nebraska*. Ph.D. Student: **Justin Gibson**, for a Ph.D. in Natural Resource Sciences (specializing in Bio-Atmospheric Interactions)

Presentations: two first author poster presentations and one co-authored poster presentation; MOISST conference in Stillwater, Oklahoma and the 2017 Water for Food Global Conference; Water for Food Research Forum (poster), April 26, 2018

Publications:

Gibson, J., Franz, T. E., Wang, T., Gates, J., Grassini, P., Yang, H., and Eisenhauer, D.: A case study of field-scale maize irrigation patterns in western Nebraska: implications for water managers and recommendations for hyper-resolution land surface modeling, *Hydrol. Earth Syst. Sci.*, 21, 1051-1062, <https://doi.org/10.5194/hess-21-1051-2017>, 2017.

Foolad, F., Franz, T. E., Wang, T., **Gibson, J.**, Kilic, A., Allen, R. G., and Suyker, A.: Feasibility analysis of using inverse modeling for estimating field-scale evapotranspiration in maize and soybean fields from soil water content monitoring networks, *Hydrol. Earth Syst. Sci.*, 21, 1263-1277, <https://doi.org/10.5194/hess-21-1263-2017>, 2017.

Changes in Knowledge: Justine Gibson is expected to complete numerous journal publications and a high-quality dissertation by the end of 2019.

- **Troy Gilmore**, Assistant Professor of Groundwater Hydrology, UNL School of Natural Resources, for the project: *Streambed water flux dynamics at coupled groundwater-surface water monitoring stations*. Masters Student: **Mason Johnson**, for an M.S. in Natural Resource Sciences and **Martin Wells**, for an M.S. in Biological Systems Engineering
DWFI support has provided training opportunities for two graduate students, Mason Johnson and Marty Wells, to conduct groundwater discharge measurements in streams and streambeds. Mason Johnson has conducted an extensive literature review and developed an MS thesis proposal centered on the project as originally proposed, focusing on distributed temperature sensing (DTS). Key outcomes include: 1) Two proposed field campaigns completed; 2) Continued collaboration with participants and partners; 3) Manuscript/thesis chapter based on first field campaign in preparation. Though temperature data collection from the second field campaign was successful, a robust comparison of physical discharge measurements at informed and uninformed locations was not possible. However, results will be published in Mason's thesis, with a focus on comparing and improving FO-DTS application under two very different field conditions in this study.
Presentations: DWFI Research Forum, May 11, 2017; Water for Food Research Forum (poster), April 26, 2018.
Changes in Knowledge: The students have benefited significantly, engaging in conversations with leading experts on DTS. Overall the project is on schedule and will lead to scientific advancement in groundwater discharge measurement techniques. As planned, the project will also increase understanding of groundwater discharge patterns in the Sandhills and in the Elkhorn River, which is critical information for Nebraska stakeholders and water resources managers.
- **Christopher Gustafson**, Assistant Professor, UNL Agricultural Economics, for the project: *Behaviors to Mitigate the Risk of Waterborne Illness: An Analysis of Pastoralist Households in Rural Tanzania*. Ph.D. Student: **Mazbahul Ahamad**, for a Ph.D. in Natural Resource Sciences
Significant progress has been made on the project. Before Mazbahul Ahamad was able to start working on the specific aims of the project, a significant amount of background work had to occur. Data cleaning, construction of variables needed for the analysis, and collection of additional information that we realized was critical for the study had to be completed before we could address the specific aims. Data cleaning is complete on year 1 and year 2 data and is nearing completion on subsequent years. We are pleased with the progress that has been made so far and are confident that with the unique dataset we have available we will be able to surpass our goal of at least two conference presentations and two journal articles.
Presentation: Ex-post Livestock Diseases, and Pastoralists' Averting Decisions in Tanzania, Agricultural and Applied Economics Association Annual Meetings, August 2016, Tanzania (with C. Gustafson and E. Van Wormer); DWFI Research Forum, May 11, 2017; Water for Food Research Forum, April 26, 2018
Changes in Knowledge: Destini Petitt is expected to graduate by spring or summer 2018 and will produce high-quality and highly-publishable empirical research as part of her graduate work.

- **Derek Heeren**, Assistant Professor of Irrigation Engineering, UNL Biological Systems Engineering, for the project: *Field Testing Variable Rate Irrigation (VRI) for Managing Spatial Variability in Soils and Evapotranspiration*; Masters Student: **Sandeep Bhatti**, for an M.S. in Biological Systems Engineering, who began his program in January 2017. The objectives of this project are to utilize field experiments to evaluate variable rate irrigation (VRI) for adapting irrigation to spatial water holding capacity and spatial evapotranspiration. A secondary objective is to develop best management practices for utilizing VRI to achieve these benefits. This research is building on the research of Himmy Lo and Burdette Barker (note: both Lo and Barker are currently receiving DWFJ support and/or working on DWFJ funded/related projects.)

Presentations: DWFJ Research Forum, May 11, 2017; DWFJ Water for Food Conference 2017 (poster); Nebraska Water Center Symposium, October, 2017 (2nd place poster); Water for Food Research Forum, April 26, 2018

Publications: Forbes, C.T., Brozovic, N., Franz, T., Lally, D., & Petitt, D. (in preparation). Towards Transdisciplinary Water Literacy: Development of an Innovative Undergraduate course. *Journal of College Science Teaching*.

As of May 2018, "I am preparing a conference proceeding paper for American Society of Agricultural and Biological Engineers (ASABE). This paper would subsequently be submitted as a peer reviewed journal manuscript, in which I will be lead author. I am also collaborating with Jingjing, who is working on computing deep percolation losses during growing season. I will be a coauthor on her journal manuscript."

Changes in Knowledge: Sandeep Bhatti is expected to graduate in December 2018.

- **Alan Kolok**, Director, Center for Environmental Health and Toxicology, UNMC College of Public Health, and Professor, UNO Biology, for a project to study the pressure that agrichemicals exert on water resources; Ph.D. Student: **Jonathan Ali**, for a Ph.D. from the UNMC College of Public Health (*Note: student initially awarded during Round One; subsequently funded as part of Round Three, match required*)

Since the start of his support from DWFJ in 2014, Ali has advanced multiple projects on behalf of the University of Nebraska both in Nebraska and abroad. All of these projects, along with his dissertation research, are focused on assessing the impacts of agricultural runoff on freshwater resources and public health both locally in Nebraska and abroad. These on-going projects were a part of the proposal for support submitted in May 2015 and include: investigate the persistence of adverse biological impacts from agricultural runoff on adult and early life stages of the environmental sentinel organism, the fathead minnow; continue on-going research on the integration of biomonitoring and citizen science for detection of agricultural runoff in Chilean watersheds; explore the use of citizen science to simultaneously monitor for agricultural contaminants and promote environmental stewardship in rural and urban watersheds.

Based on these proposed objectives, Ali has published one first author manuscript (Ali et al. 2017) and coauthored two additional manuscripts (Sangster et al. 2016; Schulze et al. 2016), with an additional three manuscripts in preparation for publication. This work has focused on the use of environmental sentinels (fish) to understand the adverse health impacts from exposure to agricultural runoff in freshwater systems. Between May 1st and June 9th, 2017, Ali is scheduled to give three presentations at national conferences on his dissertation research evaluating the compensatory mechanisms for early life exposure to agricultural runoff. In this award cycle alone, Ali has given three presentations and produced five posters presented at numerous regional and national scientific conferences and workshops (see below).

Internationally, Ali has continued work on developing methods to apply molecular tools for monitoring agricultural pollution through an on-going collaboration between his advisor Alan Kolok, Ph.D., and Nicolas Gouin, Ph.D., of the University of La Serena. Through this collaboration, Ali has also taken an undergraduate mentee, Luke Allmon, to Chile for sampling of pesticides in the waters and sediments of the agriculturally intensive Choapa River Basin. This project has produced one peer-reviewed manuscript with an additional manuscript currently in preparation that are of interest to our collaborators and other biologists and environmental scientists throughout Chile.

Outside of his rigorous laboratory and field research, Jonathan has continued to participate in community outreach and education related to water resources and public health. This has included outreach events with the Nebraska Watershed Network, as well as serving as a capstone mentor for students enrolled in the Urban Agriculture & Food Science Career Academy at Bryan High School, Omaha.

Project Presentations:

- **Ali J.M.**, Kolok A.S. and S.L. Bartelt-Hunt. (Invited) Assessing Agricultural Runoff in the Elkhorn River Watershed and Beyond: Lessons Learned and Future Directions. Indo-US Workshop on Addressing the Nexus of Food, Energy, and Water (FEW) in the Context of Societal Challenges. National Science Foundation and Indo-US Science Technology Forum. Indian Institute of Technology, Bengaluru, India. Apr 2017.
- **Ali J.M.**, Schulze T., Gouin N., Davis P.H. and A.S. Kolok. Development of a native pencil catfish (*Trichomycterus areolatus*) as a freshwater environmental sentinel of pollution in Chile. 7th Society of Environmental Toxicology and Chemistry (SETAC) World Congress/SETAC North America 37th Annual Meeting Orlando, FL, USA. Nov 2016.
- **Ali J.M.**, Schulze T., Gouin N., Davis P.H. and A.S. Kolok. Molecular Tools for Water Quality Monitoring: Development of a Native Sentinel Organism in Chile. College of Public Health Global Health Fellows 2015 Seminar, UNMC, Omaha, NE, USA. Oct 2016.
- **Ali J.M.** and A.S. Kolok. (Invited) Biomonitoring Watersheds in Nebraska and Chile: Advancing toxicity studies of agricultural runoff both near and far. Robert B. Daugherty Water for Food Institute 2016 Research Forum, University of Nebraska Lincoln, NE, USA. May 2016.
- **Ali J.M.**, Farhat Y.A. and A.S. Kolok. Exposure of fathead minnow larvae to an agrichemical pulse: altered gene expression in the field. Nebraska Chapter of the American Fisheries Society Meeting-Streams and Rivers Technical Meeting, Gretna, NE, USA. Dec 2015.
- **Ali J.M.**, Farhat Y.A. and A.S. Kolok. Altered aromatase expression in fathead minnow larvae following in situ exposure to an agrichemical pulse. Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting, Salt Lake City, UT, USA. Nov 2015.
- **Ali J.M.** and A.S. Kolok. (Invited) Novel assessment tools: Utilizing citizen science and sentinel organisms to detect agrichemical runoff. Robert B. Daugherty Water for Food Institute 2015 Research Forum, University of Nebraska Lincoln, NE, USA. May 2015.

Poster Presentations:

- **Ali J.M.**, D'Souza D.L., Singh R.P., Bartelt-Hunt S.L. and A.S. Kolok. Endocrine challenges of a Midwest upbringing: Investigating the impacts of agricultural runoff on larval fish following in situ and laboratory exposures. 2017 Water for Food Global Conference. Lincoln, NE, USA. Apr 2017. **(2nd Place Onsite Poster Competition)**
- **Ali J.M.**, Schulze T., Gouin N., Davis P.H. and A.S. Kolok. Development of a native pencil catfish (*Trichomycterus areolatus*) as an environmental sentinel for freshwater pollution in Chile. 3rd Annual Global Health Conference Midwest "Empowering Agents of Change Across Our World". Omaha, NE, USA. Feb 2017. **(Best Research Poster Award)**

- Kolok A.S. and **Ali J.M.** Too thick to drink, too thin to plow: Chemical mixtures in the Elkhorn River, Nebraska. 7th SETAC World Congress/SETAC North America 37th Annual Meeting. Orlando, FL, USA. Nov 2016.
- **Ali J.M.**, Schulze T., Kumar S., Gouin N., Davis P.H. and A.S. Kolok. Biomonitoring and Surveillance of Pesticides in the Agriculturally-Dominated Choapa River, Coquimbo, Chile. 2016 Water for Food Global Conference. Lincoln, NE, USA. Apr 2016.
- **Ali J.M.**, Rakestraw M.J., Herrmann K.M.K. and A.S. Kolok. Pesticide runoff in Midwestern Watersheds: Can citizen science help collect the data scientists need? University of Nebraska at Omaha Sustainability Launchpad: Water. Omaha, NE, USA. Apr 2016. (**1st Place Student Poster Competition**)
- **Ali J.M.**, Banan A. and A.S. Kolok. Chronic Effects of Silver Nanoparticles on Fingerling Persian Sturgeon (*Acipenser persicus*). Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting. Salt Lake City, UT, USA. Nov 2015.
- Kolok A.S., Zhang Y., Krysl R., **Ali J.M.** and S.L. Bartelt-Hunt. Muddy Waters: The role of sediment in CEC fate, transport and bioavailability. Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting. Salt Lake City, UT, USA. Nov 2015.
- Rakestraw M.J., Herrmann K.M.K., **Ali J.M.** and A.S. Kolok. Pesticides in surface water: Can citizen science help collect the data scientists need? Society of Environmental Toxicology and Chemistry 2015 North America 36th Annual Meeting. Salt Lake City, UT, USA. Nov 2015.
- **Ali J.M.**, Farhat Y.A. and A.S. Kolok. Altered aromatase expression in fathead minnow larvae following in situ exposure to an agrichemical pulse. Nebraska Environmental Health Association 2015 Meeting, Ashland, NE, USA. Oct 2015.
- Rakestraw M.J., Herrmann K.M.K., **Ali J.M.** and A.S. Kolok. Pesticides in surface water: Can citizen science help collect the data scientists need? Nebraska Environmental Health Association 2015 Meeting, Ashland, NE, USA. Oct 2015.
- Zhang Y., Krysl R.G., **Ali J.M.**, Snow D.D., Kolok A.S. and S.L. Bartelt-Hunt. Impact of Sediment on Agrichemical Fate and Bioavailability to Aquatic Organisms. Association of Environmental Engineering and Science Professors 2015 Research and Education Conference. New Haven, CT, USA. Jun 2015.
- **Ali J.M.** and A.S. Kolok. Pesticide runoff in the Elkhorn River, Nebraska, USA: Temporal variation in chemical occurrence and biological impact. Society of Environmental Toxicology and Chemistry 2014 North America 35th Annual Meeting. Vancouver, BC, Canada. Nov 2014.

Project Publications - In preparation (4):

- **Ali J.M.**, D'Souza D.L., Allmon L.G., Schwarz K.T., Singh R.P., Snow D.D., Bartelt-Hunt S.L. and A.S. Kolok. Biological Impacts Following Early Life Exposure to Water and Sediment Found in Spring Agricultural Runoff.
- **Ali J.M.**, Allmon L.G., Schulze T.T., Kallenbach A.T., Snow D.D., Davis P.H., Bertin A., Gouin N. and A.S. Kolok. Surveillance of anthropogenic stressors within a Chilean watershed utilizing a native environmental sentinel, *Trichomycterus areolatus*.
- **Ali J.M.**, Kallenbach A.T., Chavez E., Ramirez J., Onanong S., Snow D.D. and A.S. Kolok. Estrogenic impacts of early life exposure to a putative estrogen receptor antagonist, fulvestrant, in the fathead minnow.
- Knight L.A., **Ali J.M.**, D'Souza D.L., and A.S. Kolok. Exposure of two sentinel organisms, the northern leopard frog (*Lithobates pipiens*) and the fathead minnow (*Pimephales promelas*) to atrazine and a synthetic mixture of pesticides.

Project Publications - Published (7):

- **Ali J.M.**, Sangster J.L., Snow D.D., Bartelt-Hunt S.L. and A.S. Kolok. (2017) Compensatory response of fathead minnow larvae following a pulsed in-situ exposure to a seasonal agricultural runoff event. *Science of the Total Environment*, *in press*.
- Schulze T.T., **Ali J.M.**, Bartlett M.L., McFarland M.M., Clement E.J., Won H.I., Sanford A.G., Monzingo E.B., . . .Gouin N., Kolok A.S., and P.H. Davis. (2016) De novo Assembly and Analysis of the Chilean Pencil Catfish *Trichomycterus areolatus* Transcriptome. *Journal of Genomics*, 4, 29-41.
- Sangster J.L., **Ali J.M.**, Snow D.D., Kolok A.S. and S.L. Bartelt-Hunt. (2016). Bioavailability and fate of sediment-associated progesterone in aquatic systems. *Environmental Science and Technology*, 50(7), 4027–4036.
- **Ali J.M.**, Farhat Y.A., and Kolok, A.S. (2016). Biological impacts in fathead minnow larvae following a 7-day exposure to agricultural runoff: A microcosm study. *Bulletin of Environmental Contamination and Toxicology*, 96(4), 432-437.
- **Ali J.M.**, Herrmann, K.M.K., Rakestraw, M.J., and Kolok, A.S. (2016). Citizen-based scientific data collection: Fact or fiction? *Integrated Environmental Assessment and Management*, 12(2), 400-402.
- Zhang Y., Krysl R.G., **Ali J.M.**, Snow D.D., Kolok A.S. and S.L. Bartelt-Hunt. (2015) Impact of sediment on the fate and bioavailability of agrichemicals to adult female fathead minnows: a field study. *Environmental Science and Technology*, 49(15), 9037–9047.
- **Ali J.M.** and A.S. Kolok. (2015) On-site, serial exposure of female fathead minnows to the Elkhorn River, Nebraska, USA, spring agrichemical pulse. *Environmental Toxicology and Chemistry*, 34(6), 1354-1361.

Other Publications and Technical Reports (2)

- Krysl R.G., **Ali J.M.** and A.S. Kolok. (in review) Chapter 2: On-site exposure of fathead minnows (*Pimephales promelas*) in the Missisquoi River, VT, for indicators of endocrine disruption. U.S. Fish and Wildlife 2013-2014 Unit Report.
- **Ali J.M.**, Sellin Jeffries M.K. and A.S. Kolok. (2017) *Uncharted Waters: Field Ecotoxicology in Remote Locations on Limited Resources*. Society of Environmental Toxicology and Chemistry (SETAC) Globe: Session Summary. 18(1).

Changes in Knowledge: Ali earned his Ph.D. in December 2017. He accepted a position as a toxicologist with the state of New Hampshire and will begin his new position in October 2018.

- **Aaron Mittelstet**, Assistant Professor, UNL Biological Systems Engineering, for a project to improve and test the irrigation routines for both field and watershed-scale hydrological models
Aaron Mittelstet submitted a proposal to Nebraska’s Water Sustainability Fund, using the funds for this student support award as part of the matching requirement for his proposal. His proposal was funded, although not until a subsequent round. Nawaraj Shrestha joined the project in August 2018.
Student: **Nawaraj Shrestha**, for a Ph.D. in Natural Resource Sciences
- **Daran Rudnick**, Assistant Professor, UNL Biological Systems Engineering, for the project: *Sustaining Agriculture through Adaptive Management Resilient to a Declining Ogallala Aquifer and Changing Climate*. Ph.D. Student: **Tsz Him Lo**, for a Ph.D. in Biological Systems Engineering. This award supplemented the graduate research assistantship stipend for Rudnick’s Ph.D. student, Tsz Him Lo, who was recruited to join a multi-state and multidisciplinary project funded by the US Department of Agriculture (USDA) titled, "Sustaining Agriculture through Adaptive Management Resilient to a Declining Ogallala Aquifer and Changing Climate." This project is a response to decreasing groundwater levels in substantial portions of the Ogallala Aquifer. Rudnick and Lo are part of teams focusing on: developing and identifying the best irrigation technologies, cropping systems

management practices, and decision support tools to improve water use efficiency; and enable the adoption of tools and recommended strategies for improved water use through highly integrated and effective communication among the project team and technology transfer with stakeholders. Research activities have emphasized the deployment and evaluation of soil moisture sensors, thermal infrared sensors, and canopy reflectance sensors with varying spatiotemporal resolutions.

Presentations:

- Dorr, T., Singh, J., **Lo, T.**, & Rudnick, D. R. (2016). Performance analysis of factory, laboratory, and field calibrated soil water sensors for irrigation management. ASA, CSSA, & SSSA International Annual Meetings: Resilience Emerging from Scarcity and Abundance. November 6-9, 2016. Phoenix, Arizona.
- **Lo, T.**, Heeren, D. M., Luck, J. D., Haghverdi, A., & Rudnick, D. R. (2016). Developing management zones for variable rate irrigation (VRI). Invited oral presentation at UNL Extension's Technologies for Irrigation Management field day, Elgin, NE.
- Oral presentation at Daugherty Water for Food Global Institute Research Forum, Lincoln, NE.
- **Lo, T.**, Rudnick, D. R., Heeren, D. M., Luck, J. D., & Shaver, T. M. (2016). Variable rate irrigation (VRI): An introduction. Invited oral presentation at NRCS Nebraska Irrigation Forum, Grand Island, NE.
- Oral presentation at Central Plains Irrigation Conference, Burlington, CO.
- Rudnick, D. R., Dorr, T., & **Lo, T.** (2017). Irrigation scheduling using soil water sensors. Ag Innovators Series - Improving Economic Efficiency through Precision Ag Technology. January 19, 2017. Yuma, Colorado.
- Rudnick, D. R., **Lo, T.** (2016). Variable rate irrigation: How does it work and what are the advantages for the farmer. *5th International Meeting on "Efficient use of Water for Irrigation"*. Hosted by National Institute of Agricultural Technology (INTA). October 26-27, 2016. Manfredi, Cordoba Province, Argentina.
- Shaver, T. M., Ferguson, R. B., Rudnick, D. R., & **Lo, T.** (2017). Integrating variable rate nitrogen and variable rate irrigation management: Opportunities and challenges. Oral presentation at Central Plains Irrigation Conference, Burlington, CO.
- Singh, J., **Lo, T.**, Rudnick, D. R., Dorr, T. J., Burr, C. A., Werle, R., Shaver, T. M., & Muñoz-Arriola, F. (2017). Performance analysis of electromagnetic soil water sensors in a loam soil. Poster presentation at Water for Food Global Conference, Lincoln, NE.

Publications:

- **Lo, T.**, D.R. Rudnick, Y. Ge, D.M. Heeren, S. Irmak, J.B. Barker, X. Qiao, T. M. Shaver (2018). [Ground-Based Thermal Sensing of Field Crops and Its Relevance to Irrigation Management \(Nebraska Extension Publication G2301\)](#)
- Rudnick, D.R., **T. Lo**, J. Singh, R. Werle, F. Muñoz-Arriola, T. Shaver, C.A. Burr, and T.J. Dorr (2018). [Letter to the Editor: Reply to comments on "Performance assessment of factory and field calibrations for electromagnetic sensors in a loam soil"](#). *Agricultural Water Management* 203 (2018) 272–276.
- Singh, J., **T. Lo**, D.R. Rudnick, T.J. Dorr, C.A. Burr, R. Werle, T.M. Shaver, & F. Muñoz-Arriola. (2018). [Performance assessment of factory and field calibrations for electromagnetic sensors in a loam soil](#). *Agricultural Water Management*, 196:87-98
- **Lo, T.**, Rudnick, D. R., & Shaver, T. M. (2017). Sensor-based site-specific management of irrigation and fertilizer.
- **Lo, T.**, Rudnick, D. R., Heeren, D. M., Luck, J. D., & Shaver, T. M. (2017). Fundamentals of variable rate irrigation.

- Singh, J., **Lo, T.**, Rudnick, D. R., Dorr, T. J., Burr, C. A., Werle, R., Shaver, T. M., & Munoz-Arriola, F. (2017). Performance analysis of electromagnetic soil water sensors in a loam soil. Manuscript under review.

Changes in Knowledge: Tsz Him Lo plans to graduate in December 2018. The overarching multi-state, multi-disciplinary project is expected to continue. In addition to presentations and publications, more deliverables, such as software tools and technical contributions, are expected.

Changes in Action: This project has also generated synergy with three other projects:

- a USDA-funded project on fertigation, seeking to reduce nitrogen inputs and groundwater contamination while maintaining or improving economic outcomes;
- a USDA-funded project on integrating and evaluating unmanned aircraft systems and a remote sensing- driven evapotranspiration model, with which three DWFI-supported graduate students are associated; and
- UNL Testing Ag Performance Solutions (UNL-TAPS) 2nd Annual Farm Management Competition (www.taps.unl.edu), which engages corn producers simultaneously on the same field as a basis for innovative research and extension. Tsz Him Lo has assisted with all these projects and looks forward to increasing opportunities to collaborate in mutually beneficial ways.

Round Four

In 2017 eleven awards were given to support graduate student research, ten of which are still active in FY19. Faculty Fellows secured additional funds on their own to support the students, matching DWFI funds one-to-one. Undergraduate student support was also awarded once again to the Platte River Timelapse Project.

- **P. Stephen Baenziger**, Professor, UNL Agronomy & Horticulture, for the project: *Genetic Architecture of Male Traits for Hybrid Wheat Seed Production*. Ph.D. Student: **Nicholas Garst**, for a Ph.D. in Agronomy (Plant Breeding and Genetics Emphasis)
Hybridizing traditionally self-pollinated crops such as wheat offers both yield advantages of 3.5% to 15% and greater yield stability when compared to commercial self-pollinated cultivars. Hybrid wheat was attempted in the past with low commercial success due to the high cost of seed to the producer. If hybrids are to be deployed on a large scale, seed production costs need to decrease. This can be accomplished by changing the floral architecture of the wheat spike to encourage outcrossing. In this study, Mr. Garst is working on the male characteristics to facilitate pollination in hybrid wheat production fields.
Presentations: Nicholas has presented his masters and initial Ph.D. work at International Annual Meeting of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America (Minneapolis, MN, November 2015), International Wheat Yield Partnership Grant Meeting at the Plant and Animal Genome Conference (January, 2017), International Wheat Yield Partnership Hybrid Wheat Update Meeting (April, 2018), and Daugherty Water for Food Conference (April, 2018).
Changes in Knowledge/Action: The 2018 HWWAMP should provide better results than 2017 and will benefit from additional part time labor which should enable more traits to be measured. The 2018 phenotyping should be completed by June 2018 with analyses on phenotype and genomics concluded by winter 2018-2019.
- **Yufeng Ge**, Assistant Professor, UNL Biological Systems Engineering, for the project: *Integrated crop and soil water sensor network to assist UAS and soil water simulation modeling in variable rate irrigation* Ph.D. Student: **Jasreman Singh**, for a Ph.D. in Biological Systems Engineering (Soil and Water Resources Engineering Emphasis).
Five sensor nodes were installed in the VRI field at Mead in the 2017 season. The sensor node included the NDVI sensor, the IRT canopy temperature sensor, and 3 volumetric soil moisture sensors at three depths. In 2018, we worked to add more sensing capabilities to the sensor node with additional micro-environmental sensors (for solar radiation, wind speed, air temperature and relative humidity). We also worked with the collaborator at Colorado State University on wireless data communication between UAV and sensor nodes (the data-mule concept). Field work planned for the 2018 season includes the installation of 12 sensor nodes.
Presentations: Jasreman will present the project and findings at ASABE (July 2018).
- **James D. Goedert**, Professor, Durham School of Architectural Engineering and Construction, for the project: *Growing Haiti*
The first student recruited for the project transferred; a subsequent student has yet to be recruited.

- **Jesse Korus**, Assistant Professor, UNL School of Natural Resources, for the project: *Improving Groundwater Characterization and Management through Integration of Airborne Electromagnetics (AEM) and Borehole Data*
Masters Student: **Jaqueline Polashek**, for a M.S. in Natural Resource Sciences
Presentations: Live demonstration of the GeoScene3D project to ~120 water resources managers, specialists, and technicians at the annual NRD Water Programs conference; Water for Food Research Forum, April 26, 2018;
Changes in Action: The project has been successful. Ms. Polashek has finalized her MS research proposal and presented it to her committee. We have had very productive meetings with the Lower Platte North NRD and the NE Department of Natural Resources, identifying mutual benefits of the project for all partners, resulting in a tentative agreement by our sponsors to co-fund additional monitoring sites in the study area. The agreement will result in an additional \$32,000 from project sponsors, plus \$12,000 from a grant to Dr. Korus, totaling \$44,000 for monitoring instrumentation. The instruments will be used for research as well as groundwater management.

- **Taro Mieno**, Assistant Professor, UNL Agricultural Economics, for the project: *Farmer adaptation to low well yields in high-productivity irrigated agriculture*
Student: **Paloch Suchato**, for a M.S. in Agricultural Economics
Our preliminary results suggest that insurance does not affect the amount of irrigation water that a producer chooses to apply. However, this is a very preliminary result, and we are skeptical of this outcome. There are some biases associated with these estimates, because they only include the risks that are incorporated in Aquacrop-OS (i.e., most of the weather-related production risks), but not all of them, such as hail damage. Because of this deficiency, our preliminary results suggest that farmers are better off without crop insurance at all, which seems to be at odds with USDA RMA reports about how widespread crop insurance coverage is in the region. Thus, we turned to data maintained by the USDA Risk Management Agency, and we found that there are indeed significant numbers of claims for hail damage. One of our next steps is to incorporate this kind of production risk into the analysis so that the value of crop insurance reflects all of the risks facing agricultural producers.
Presentations: Water for Food Research Forum, April 26, 2018

- **Xu Li**, Associate Professor, UNL Civil Engineering, for the project: *Determination of Setback Distance Requirements for Reducing Contaminants in Agricultural Runoff Following the Land Application of Swine Manure Slurry* Masters Student: **Maria Cecilia Hall**, for a M.S. in Environmental Engineering
Presentations (poster): Water for Food Research Forum, April 26, 2018
Changes in Knowledge/Action (anticipated): A large experimental data set has been generated for the two National Pork Board projects. The data generated will be used to write at least three manuscripts. Through these publications, the findings from the project could reach both the research community and the stakeholders (i.e., livestock and crop producers). When producers use the findings from the study to treat and apply livestock manure, it is expected that manure-borne antibiotics and ARGs, two classes of contaminants of emerging concerns, will have less negative impacts on surface water under agricultural influences.

- **Yusong Li**, Associate Professor, UNL Civil Engineering, for the project: *Influence of Climate and Agricultural Clustering on Groundwater Contamination by Trace Organics*
Ph.D. Student: **Chuyang Liu**, for an Ph.D. in Civil Engineering
Publications and Presentations:
 - Akbariyeh, S.; Bartlet-Hunt, S.; Snow, D.; Li, X.; Tang, Z., and Li, Y., Three-Dimensional Modeling of Nitrate-N Transport in Vadose Zone: Roles of Soil Heterogeneity and Groundwater Flux. *Journal of Contaminate Hydrology*. Vol 211, April 2018, Page 15-25. <https://doi.org/10.1016/j.jconhyd.2018.02.005>
 - Akbariyeh, S.; Gomez, C. ; Bartelt-Hunt, S.; Li, Y Predicting Nitrate Transport under Future Climate Scenarios beneath the Nebraska Management Systems Evaluation Area (MSEA) site , AGU Fall Conference, New Orleans, December 11-15, 2017.
 - Akbariyeh, S.; Gomez, C.; Barrios, R.; Li, X.; Bartelt-Hunt, S.; Li, Y., Predicting nitrate transport under future climate conditions for agricultural lands. MGWA Fall Conference, St. Paul, MN, November 15, 2017.
 - Akbariyeh, S.; Gomez, C.; Barrios, R.; Li, X.; Bartelt-Hunt, S.; Li, Y., Impacts of climate change on nitrate transport beneath a center-pivot irrigated corn field. AEESP Conference, June 22-27, 2017, Ann Arbor, MI.
 - Bartelt-Hunt, S.L. and Li, Y. (2018). Influence of climate on the fate of trace organics in groundwater. Water, Sustainability and Climate Investigator’s Meeting, Washington D.C., Jan 29-31, 2018.
 - “9th International Congress on Environmental Modelling and Software-Modelling for Sustainable Food-Energy-Water Systems”(iEMSs 2018), June 24-28, in Fort Collins, Colorado.

- **Adam Liska**, Associate Professor, UNL Biological Systems Engineering and Agronomy & Horticulture, for the project: *Livestock Thermodynamics & Agricultural Energy Productivity Gaps in Sub-Saharan Africa*
Masters Student: **Calvin Harman**, for a Ph.D. in Natural Resource Sciences (Human Dimensions)
Publications and Presentations:
 - Master’s Thesis—CT Harman, Thermodynamic Limitations to Agricultural Productivity and Food Security: Livestock in Sub-Saharan Africa, Dec. 2017, Agricultural & Biological Systems Engineering. Currently embargoed: <https://digitalcommons.unl.edu/embargotheses/118/>
 - Presentation—CT Harman, ‘Thermodynamic Limitations to Agricultural Productivity and Food Security: Livestock in Sub-Saharan Africa’. Water for Food Research Forum, April 26, 2018.

- **James C. Schnable**, Assistant Professor, UNL Agronomy & Horticulture, for the project: *Optimizing the water use efficiency of C4 grain crops using comparative phenomics and crop models to guide breeding targets* Ph.D. Student: **Daniel Santana de Carvalho**, for a Ph.D. in Agronomy & Horticulture
Publications and Presentations:
This project has resulted in three major outputs to date: i) a video discussing the relevance of studying water use efficiency in C4 grasses as a way to relief the strain in water resources (<https://www.youtube.com/watch?v=uF02kuE4Qn0&feature=youtu.be>); ii) an oral presentation about water use efficiency in C4 grasses at the Water for Food Research Forum (April ‘18); and iii) a planned presentation at The 3rd International Symposium on Broomcorn Millet in August 2018 in Fort Collins, Colorado (<https://extension.unl.edu/statewide/panhandle/international-millet-symposium-2018/>). Daniel Santana de Carvalho was invited to present about how the images collected can help us improve proso millet breeding, helping us predict how the

plant grows, quantify differences in water use efficiency between different cultivars and nondestructively monitor the uptake of nutrients (such as nitrogen and phosphorus) in vivo throughout the lifecycle of the plants.

- **Karina Schoengold**, Associate Professor, UNL Agricultural Economics, for the project: *The Effects of Institutions and Hydrological Conditions on Optimal Management of a Shared Aquifer: a case study of the High Plains*

Student: **Qianyu Zhang**, for a M.S. in Agricultural Economics

Presentation: Water for Food Research Forum, April 26, 2018

- **Karrie Weber**, Associate Professor, UNL School of Biological Sciences, for the project: *Mobilization of Naturally Occurring Uranium into Groundwater* Ph.D. Student: **Jeffrey Westrop**, for a Ph.D. in Geology

Publications and Presentations:

- Westrop, JP., Hu, Q., Swindle, AL., et al. 2016. Manganese-Bearing Dolomite Dissolution Drives Hexavalent Chromium Occurrence in the Central Oklahoma Aquifer, *Applied Geochemistry* (In Review).
- Westrop, JP., Nolan, J., Healy, O., et al. 2016. Nitrate Stimulated Uranium Mobilization into Groundwater. Nebraska Water Symposium: Managing and Essential Resource...Basin by Basin. Lincoln, NE. 1st Place Poster Presentation.
- Westrop, JP., Hu, Q., Swindle, AL., et al. 2016. Manganese-Bearing Dolomite Dissolution Drives Hexavalent Chromium Occurrence in the Central Oklahoma Aquifer, Geological Society of America, Denver, Colorado.
- Elwood-Madden, AS., Westrop, JP., Swindle, AL., et al. 2014. Linking Sediment-Hosted and Groundwater-Mobile Mineral Nanoparticles in the Central Oklahoma Aquifer, Goldschmidt Conference, Sacramento, California, Abstract, p. 2693.
- Westrop, JP., Swindle, AL., Sexton, MR., et al. 2013. Colloidal Transport of Nanoscale to Microscale Grains in The Central Oklahoma Aquifer, Geological Society of America, Denver, Colorado. Abstracts. Vol 45, No. 7, p.879.

Peer-Reviewed Publications:

- Pan, D., R. Watson, D. Wang, Z. H. Tan, D. Snow, **K. A. Weber**. 2014. Correlation between viral production and carbon mineralization under nitrate reducing conditions in aquifer sediment. *The ISME Journal*. 8: 1691-703. doi:10.1038/ismej.2014.38
- Nolan, J. P., **K. A. Weber**. Natural uranium contamination in major US aquifers linked to nitrate. 2015. *Environmental Science and Technology Letters*. 2: 215-220. doi:10.1021/acs.estlett.5b00174 *Press coverage *Highlighted as Editor's Choice in *Science*
- Pan, D., J. Nolan, K. H. Williams, **K. A. Weber**. 2017. Abundance and distribution of viruses in an alluvial aquifer in the Colorado River floodplain. *Frontiers in Microbiology*. 8: 1199.
- Pan, D., K. H. Williams, M. Robbins, **K. A. Weber**. Influx of dissolved oxygen stimulates uranium immobilization and virus production in a reduced aquifer. (*in revision Environmental Science and Technology*)
- Nolan, J.P. S. Bone, K. Campbell, D. Pan, O. Healy, C. Elofson, R. M. Joeckel, M. Stange, T. Wilson, P. Hanson, J. Bargar, and **K. A. Weber**. Naturally Occurring Uranium in an Oxidic Alluvial Aquifer. (in preparation for *Chemical Geology*)

Presentations (since submission in 2017):

- **Weber, K. A., J Westrop**, J. P. Nolan, S. Bone, J. Bargar, K. Campbell-Hay, and D. Snow. Microbially-mediated metal/radionuclide oxidation coupled to nitrate reduction in an alluvial aquifer. American Chemical Society Spring Meeting. New Orleans, LA. March 18-22, 2018.
- **Weber, K. A., J Westrop**, J. P. Nolan, S. Bone, J. Bargar, K. Campbell-Hay, and D. Snow. Microbially-mediated metal/radionuclide oxidation coupled to nitrate reduction in an alluvial aquifer. American Chemical Society Spring Meeting. New Orleans, LA. March 18-22, 2018.
- **Weber, K. A., J Westrop**, J. P. Nolan, S. Bone, J. Bargar, K. Campbell-Hay, and D. Snow. Microbially-mediated metal/radionuclide oxidation and mobility of naturally occurring uranium. International Society for Subsurface Microbiology Symposium. Rotorua, New Zealand. November 6-10, 2017.
- **Westrop, J.**, J. P. Nolan, S. Bone, J. Bargar, A. Kohtz, D. Snow, and **K. A. Weber**. Mobilization of naturally occurring uranium in response to nitrate inputs into subsurface sediments. Geological Society of America Annual Meeting. Seattle, Washington, October 22-25, 2017.
- **Weber, K. A.** Life beneath our Feet: Influence on Water Quality—Nitrate and Uranium. Indo-US Workshop Addressing the Nexus of Food, Energy and Water. Bangalore, India. April 20, 2017.

- **Michael Farrell and Mike Forsberg**, Assistant Professors of Practice, UNL Agricultural Leadership, Education and Communication, **for the Platte Basin Timelapse Project**. Students: **Merika Andrade, Joe Arneson, Grace Bullington, Michaela Daugherty, Mikaela Deptula, Ethan Freese, Carlee Koehler, Mariah Lundgren, Alex (Alexandria) Lundvall, Zoe Mays, Amy Morris, Grant Reiner, Gabriella Parsons, Andrew Wentz**
Presentations: Key to this Platte Basin Timelapse Project's success so far has been recruiting and training a pool of emerging talented young people through paid internships.
 - *Global Water for Food Conference*, Seattle, Washington, October 19-22, 2014 (poster)
 - DWFI Student Support Research Forums, 2015-2018.
 - Sunday with a Scientist, Lincoln, NE, June 12, 2016.
 - Timelapse videos available at: <http://plattebasintimelapse.com/>
 - Developed a large screen display for public engagement at the Crane Trust Visitors' Center.**Changes in Knowledge:** Mariah Lundgren graduated December 2014 and is now working part-time for the project supervising interns. Joe Arneson graduated May 2015. The following graduated May 2018: Merika Andrade, Grace Bullington, Ethan Freese, Alex (Alexandria) Lundvall, Grant Reiner.
Changes in Action: The project has established funding relationships with the Nebraska Corn and Soybean Boards and several others.

Round Five

In 2018 nine awards were given to support graduate student research. Again, Faculty Fellows secured additional funds on their own to support the students, matching DWFI funds one-to-one. Note: one award (to Bruce Dvorak for Shaobin Li) is for summer support only. Derek Heeren and Bing Wang have opted to delay the start of their awards until January 2019.

- **Cody Creech**, Assistant Professor, UNL Agronomy & Horticulture, for the project: *Wheat Residue Management to Enhance Soil Water Conservation*
Student: **Luana Machado Simão**, for a M.S. in Agronomy
- **Bruce Dvorak**, Professor, UNL Civil Engineering & Biological Systems Engineering, for the project: *Framework for assessing microbial reduction and environmental impacts of food systems: Implications on improving water conservation and wastewater quality in U.S. beef processing industry* Student: **Shaobin Li**, for a Ph.D. in Civil Engineering with specialization in Environmental Engineering (expected graduation: August 2019)
- **Roger Elmore**, Professor, UNL Agronomy & Horticulture, for the project: *Isolating Primary Factors for Corn Ear Formation Issues* Student: **Osler Antonio Ortez-Amador**, for a Ph.D. in Agronomy
- **Derek Heeren**, Assistant Professor, UNL Biological Systems Engineering, for the project: *Sensor-Based Irrigation Management for Maize and Soybean in the Great Plains* Student: to begin Jan. 2019
- **Deepak Keshwani**, Associate Professor, UNL Biological Systems Engineering, for the project: *Integrated modeling and analysis of the Corn-Water-Ethanol-Beef System* Student: **Luke Monhollon**, for a M.S. in Biological Systems Engineering
- **Tiffany Messer**, Assistant Professor, UNL Biological Systems Engineering, for the project: *Understanding Floating Treatment Wetland Potential for Toxic Algal Bloom Prevention in Recreational Lakes* Student: **Mary Keilhauer**, for a M.S. in Hydrological Sciences, Minor in Biosystems Engineering (expected graduation: May 2019)
- **Siamak Nejati**, Assistant Professor, UNL Chemical & Biomolecular Engineering, for the project: *Synthesis and Development of the Task-specific Nitrate Adsorbents*
Student: **Elham Tavakoli**, for a Ph.D. in Chemical & Biomolecular Engineering
- **Amy Millmier Schmidt**, Assistant Professor, UNL Biological Systems Engineering & Animal Science, for the project: *Transforming Manure and Cedar Mulch from “Waste” to “Worth”* Student: **Agustin José Olivo**, for a M.S. in Biological Systems Engineering
- **Bing Wang**, Assistant Professor, UNL Food Science & Technology, for the project: *Treatments for Water Used at Pre-harvest Stage to Mitigate Human Exposure to Microbial Hazards through Consumption of Frozen and Fresh Raspberry in Chile* M.S. student to begin January 2019