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2017

LOCAL TO GLOBAL: DEVELOPING SOLUTIONS AND CREATING IMPACTS. Annual Report FY 2017

Robert B. Daugherty Water for Food Global Institute

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A hand is shown holding a small amount of water, with a single drop falling towards a rice plant. The background features a world map and a sunburst effect in the upper right corner. The text is overlaid on the top right of the image.

LOCAL TO GLOBAL: DEVELOPING SOLUTIONS AND MAKING IMPACTS

ANNUAL REPORT

FY2017 (July 1, 2016 to June 30, 2017)



Water for Food
DAUGHERTY GLOBAL INSTITUTE
at the University of Nebraska

FOREWORD

The Robert B. Daugherty Water for Food Global Institute at the University of Nebraska cultivated growth and change this year. We bid farewell to Founding Executive Director Roberto Lenton, who returned to his faculty role in the Department of Biological Systems Engineering in the Institute of Agriculture and Natural Resources the University of Nebraska–Lincoln. And we welcomed Peter G. McCornick as the new executive director in late August 2016. Peter joined the DWFI after fulfilling 30 years of leadership roles in water and agricultural organizations around the world, most recently with the International Water Management Institute based in Colombo, Sri Lanka.

We also said goodbye to a wonderful friend and wise adviser, Jeff Raikes, co-founder of the Raikes Foundation, who retired from the DWFI board of directors in May 2017 to pursue other important philanthropic ventures. Jeff was one of the founding board members of the institute, joining Mogens Bay, chairman of the Robert B. Daugherty Foundation, and J.B. Milliken, who was president of the University of Nebraska at the time, to help guide the institute's mission through the early years of development. His business acumen, ability to navigate complicated scenarios and passion for solving big challenges were instrumental in helping the institute gain ground quickly. We greatly appreciate Jeff's service to the board and we will continue to keep him apprised of our work as a valued stakeholder.



Hank M. Bounds, President,
University of Nebraska

This fall, we were fortunate to have Howard W. Buffett and Senator Mike Johanns (R-NE, retired) accept our invitations to join the board of directors. Howard has broad experience in agricultural development, policy, philanthropy, international relations and academia. He cares deeply about the mission of the institute and the vital role higher education plays in solving the most urgent global challenges. Former U.S. Agriculture Secretary and Nebraska Senator Mike Johanns is recognized worldwide as a leader in agriculture and development, serving at virtually every level of government and



JAYSON BERTO

Harvesting rice, Philippines

successfully leading large and complex organizations over the past three decades. We look forward to the knowledge and perspectives these outstanding new board members will bring to benefit the Daugherty Water for Food Global Institute.

As evidenced in this annual report, the institute's success depends on collaboration and support. I encourage you to get involved with our mission. Through funding, participating in events or just engaging through social media, you can be a part of this ambitious effort to grow more food for our growing world in a sustainable manner.

Hank M. Bounds, Ph.D.

President, University of Nebraska

Chair, Robert B. Daugherty Water for Food Global Institute Board of Directors

PREFACE

The Daugherty Water for Food Global Institute was designed to enhance and expand key strengths of the University of Nebraska in agricultural research and water management. Together with more than 100 Faculty Fellows, Global Fellows, post-doctoral researchers and students in a wide variety of fields, the institute is making great progress toward increasing water and agricultural productivity.

Working collaboratively and across a wide variety of disciplines, we have opened doors to innovative solutions and best practices in water for food development. Among the many examples you'll find in the following pages, you'll see how we teamed with the USDA to explore the use of water markets as a tool for effective groundwater management and environmental stewardship. Staff worked with partners to create new software, AquaCropOS, which easily integrates with other programs to develop models that help producers make informed decisions on inputs, planting time and other farming variables. With colleagues at UNL's National Drought Mitigation Center, we are evaluating water productivity and developing a drought monitoring system in the Middle East and Northern Africa. Faculty Fellows are flying unmanned aircraft (drones) over crops to evaluate drought stress in specific areas, leading to greater precision in variable rate irrigation. And, others are measuring water and agricultural productivity gaps in more than 50 countries.



We increase the impact of our research through education, sharing knowledge and engaging our stakeholders and partners at the state, national and international levels. Through the annual Water for Food Global Conference and principal roles in other major water and food security events and projects, we have achieved a reputation for leadership and convening capacity. This year's conference welcomed more than 425 participants and featured 100 speakers and panelists who shared case studies and expertise on a range of topics related to the theme, "Water for Food Security: From Local

Peter G. McCornick,
Executive Director,
Robert B. Daugherty Water
for Food Global Institute

Lessons to Global Impacts.” An important outcome of the conference was an invitation from the World Bank, USDA and USAID to co-host a follow-up international conference in Washington, D.C., in January 2018.

We experienced growth within the institute, as well. We welcomed C.K. Duryea as director of development to broaden our network of supporters, building long-term sustainability. C.K. has nearly 20 years of development experience, working previously at the Salvation Army, Methodist Hospital Foundation, World Vision, Children International and now the University of Nebraska Foundation. We also added the talents of Lameck Odhiambo, irrigation specialist and research associate professor, UNL; Yulie Meneses, water for food processing specialist and research assistant professor, UNL; Lacey Bodnar, research project manager; Ben Beckman, research and extension communications specialist; and Amber Poythress, events coordinator. I am very proud of the strong team we have assembled to address the enormous challenge of ensuring global water and food security. I hope you will share our sense of accomplishment for what we’ve achieved in the past year and join us as we work toward even greater impact in the years to come.



Peter G. McCornick, Ph.D., P.E., D.WRE
Executive Director
Robert B. Daugherty Water for Food
Global Institute at the University of Nebraska







**LOCAL TO GLOBAL:
DEVELOPING SOLUTIONS
AND CREATING IMPACTS**





The Daugherty Water for Food Global Institute (DWFI) at the University of Nebraska works globally, nationally and in Nebraska to resolve the complex challenge of achieving greater food security with less pressure on our scarce water resources. In fiscal year 2017, we continued to leverage our leadership, partnerships and resources to create real-world impacts through improved water use and management in agriculture.

With activities in more than 70 countries, the institute and its wide network of partners and affiliated faculty across the globe are developing solutions to the world's water and food security challenges by advancing research, policy and technological innovations, sharing knowledge, and developing capacity through education, outreach, and communication.

Central to the institute's ability to make a difference is our role as a convener of many constituent parts — the private sector, academia, government, philanthropic organizations and more. The institute's broad scope of events, meetings and presentations in the last year demonstrates our ability to help break through silos, providing opportunities to learn from each other as we move toward the common goal of achieving greater food security with less pressure on the planet's scarce water resources.

The institute draws on a talented pool of Faculty Fellows, nearly 100 interdisciplinary faculty members from across Nebraska's four campuses; Global Fellows, a group of 18 affiliated faculty and researchers external to the University whose geographic locations enhance the institute's global reach; and our group of visiting scholars, postdoctoral



(W)e continued to leverage our leadership, partnerships and resources to create real-world impacts through improved water use and management in agriculture.



Director of Policy Nick Brozović (right) talks with a farmer in Dodoma, Tanzania.

researchers, students and interns. DWFI's institutional partners, the National Drought Mitigation Center (NDMC) at Nebraska and other units within the university system. Various national and international partners in the private and public sectors also help to strengthen our scope of influence.

In Nebraska, much of DWFI's work is carried out by the Nebraska Water Center (NWC) and the Water Sciences Laboratory, one of 54 national water centers in land grant universities mandated by Congress in 1964. NWC is a vital resource in advancing the institute's public health and ecosystems research and has been instrumental in establishing Nebraska's leadership in water research, teaching, extension and outreach.

Focus Areas: Where we are headed

We are committed to helping the world efficiently use its limited freshwater resources to ensure food security for current and future generations. The diversity of projects and activities in this report reflects the complexity of the challenges we face in achieving this goal through technical and policy research, education and communication.

Our research and policy development efforts are focused within five areas to maximize the expertise of DWFI staff, our colleagues at the National Drought Mitigation Center (NDMC) and leadership of the University of Nebraska:

- ▶ Closing water and agricultural productivity gaps
- ▶ Improving groundwater management for agricultural production
- ▶ Enhancing high productivity agriculture
- ▶ Supporting freshwater and agricultural ecosystems and public health
- ▶ Managing agricultural drought, focusing on drought monitoring and mitigation across all other research areas

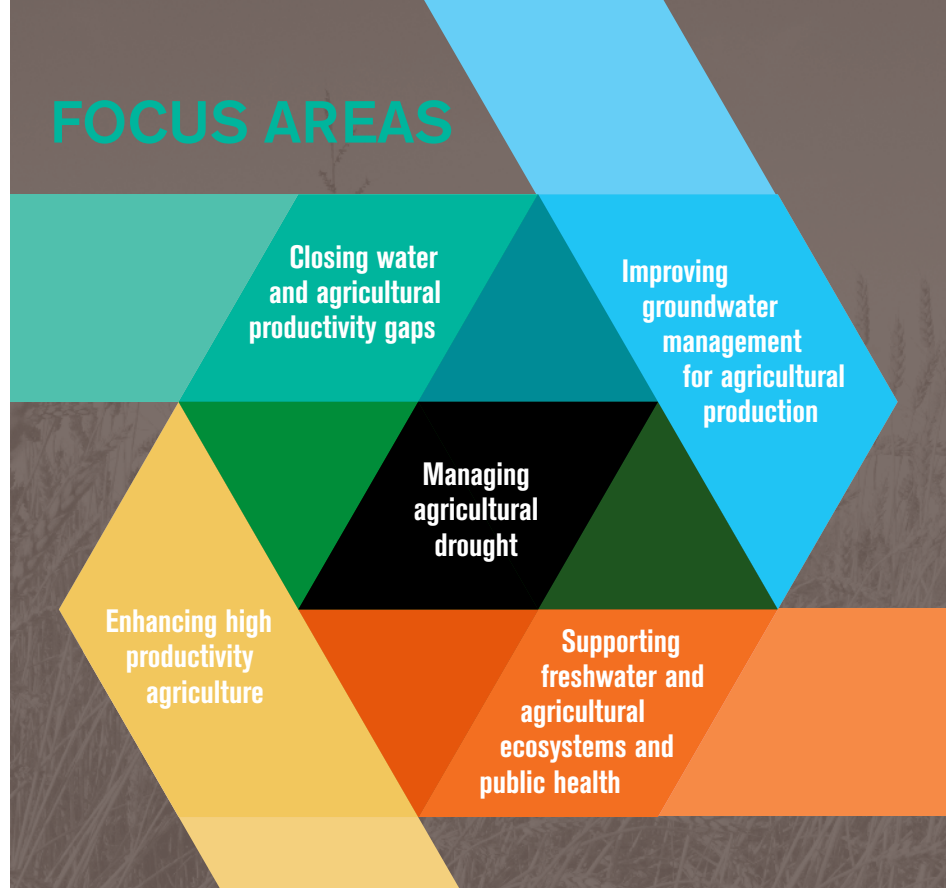
Within these important areas, we have outlined a clear set of outcomes to achieve by 2020, which involve creating changes in behavior, knowledge or condition that advance our mission. These intended outcomes have guided our activities and projects over the last year, and have focused primarily on important food-producing regions

of the world, including sub-Saharan Africa, India, the Middle East and North Africa, Latin America and the United States.

To help close water and agricultural productivity gaps, we are working to develop satellite-based decision support tools based on evapotranspiration estimates in key areas of potential agricultural improvement, such as the MENA region and the Dominican Republic. We are collaborating with farmers, water managers and private sector suppliers to adopt technology and best practices that will improve water productivity in key agricultural areas in Nebraska and participating countries.

The institute is a leading voice for improving groundwater management in agricultural production. Within this focus area, we are working to identify and communicate cost-effective groundwater management policies, considering factors such as local context, climate conditions and constraints in the U.S. and selected countries. Our team is also promoting effective groundwater governance and policy through education and pilot programs that demonstrate best management practices and highlight innovative technology and exemplary institutions. Additionally, we are developing new methods to monitor improvements in groundwater conditions in selected areas that are degraded in terms of quality, streamflow or depletion.

The institute has also prioritized projects that enhance high-productivity irrigated agriculture, including efforts to help identify and improve knowledge of cost-effective practices for water and energy use in agriculture, and ultimately, to

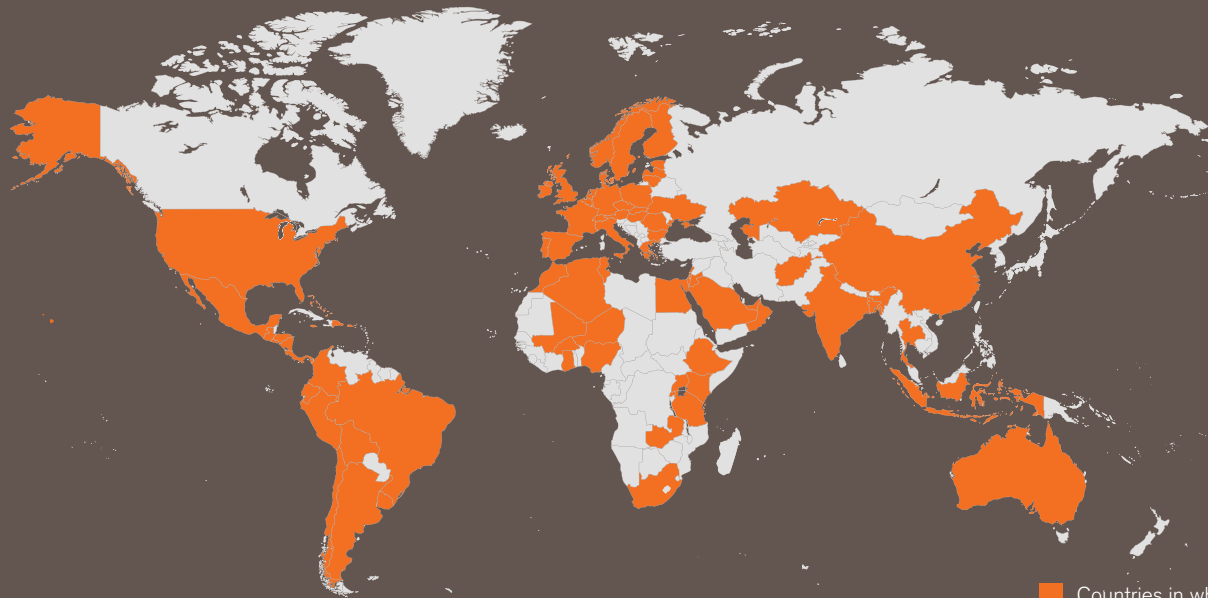


influence producers and other stakeholders to adopt new technology and best practices. We are documenting the improved efficiency of water and energy use in agricultural production that results from our activities and those of our Faculty Fellows.

Supporting freshwater and agriculture ecosystems and public health is another priority for the institute. Projects that fall under this umbrella include developing new methods to facilitate the adoption of new knowledge about water re-use in dairy and other food processing industries and also influencing the adoption of agricultural practices that minimize the

OUR PROJECTS

The institute and our Faculty Fellows are engaged in water and food security-related projects in 77 countries.



Countries in which we work

Afghanistan
Algeria
Argentina
Australia
Austria
Bangladesh
Belgium
Bolivia
Brazil
Bulgaria
Burkina Faso
Czech Republic
Chile
China
Colombia
Costa Rica

Denmark
Dominican Republic
Ecuador
El Salvador
Egypt
Estonia
Ethiopia
Finland
France
Germany
Ghana
Greece
Guatemala
Honduras
Hungary
India

Indonesia
Ireland
Israel
Italy
Jamaica
Jordan
Kazakhstan
Kenya
Latvia
Lebanon
Lithuania
Luxemburg
Mali
Mexico
Morocco
Netherlands

Nicaragua
Niger
Nigeria
Norway
Oman
Palestine
Panama
Peru
Poland
Portugal
Puerto Rico
Rwanda
Romania
Saudi Arabia
Slovenia
South Africa

Spain
Sweden
Switzerland
Tanzania
Thailand
Tunisia
Uganda
Ukraine
United Arab Emirates
United Kingdom
United States
Uruguay
Zambia

negative impacts of water quality in Nebraska and selected countries. Additionally, the institute is a global thought leader in water markets, and is working to influence the adoption of viable water markets in selected U.S. regions and countries.

Woven through all of our research and policy efforts is a focus area that touches many food-producing regions of the world: the need to effectively manage agricultural drought. The institute works closely with the NDMC on projects that develop and disseminate information and tools to help build resilience to drought in agricultural systems in selected countries and regions, particularly MENA. Our intended outcome is to influence the adoption of tools and policies that will reduce vulnerability and build agricultural resilience to drought in selected U.S. regions and countries.

Lastly, education, engagement and communication projects are a central focus for the institute, as we continue to develop programs that increase knowledge of water for food issues among key stakeholders in the U.S. and internationally and build capacity to meet complex water for food challenges. Our programs in this area – including internships, seminars, conferences, and other meetings – benefit students, agricultural producers, water managers and other decision-makers. We also offer professional development to DWFI-funded students and researchers to influence their chosen career path in the water and agriculture sectors. Our communication efforts encourage information sharing and open dialogue through



a variety of media to reach our local, regional and international stakeholders.

While these outcomes provide measurable, as well as some less easily quantifiable, impacts toward the institute's mission to achieve global water and food security – this challenge requires a network of partners, working collaboratively and from a variety of approaches, over months and years to affect change. The reports, conferences, student and faculty projects and innovative products developed in the past year are a testament to the solid foundation set in the organization's early years. The institute's achievements are making a bigger impact as research matures and partnerships develop.

This year's report highlights the progress we have made toward achieving these outcomes and where we are headed.

Faculty Fellow Eleanor Rogan of the University of Nebraska Medical Center provides comments at the Faculty Fellow Dialogue, January 2017.



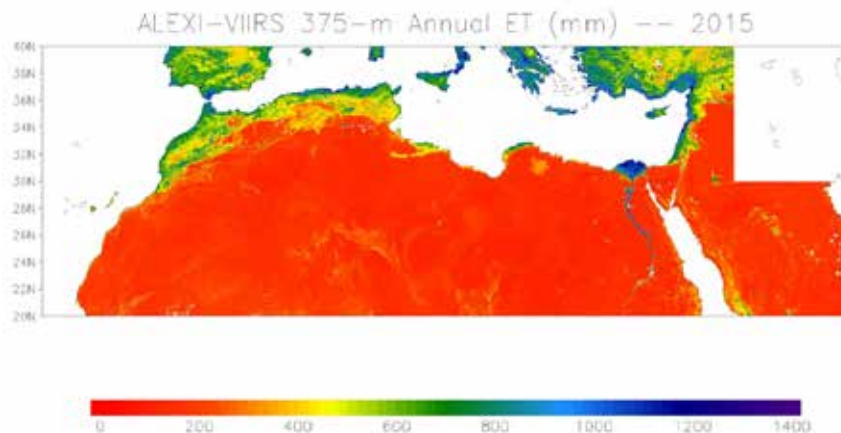
**CLOSING WATER
AND AGRICULTURAL
PRODUCTIVITY GAPS**

Developing a satellite-based global daily evapotranspiration product to address MENA's water challenges and improve water productivity

Data gathered by the institute's satellite-based global daily evapotranspiration product will help inform water and crop management decision-making in the MENA region, one of the most tenuous and water-scarce areas of the world. In the future, we hope to extend the data system globally to help other food-producing regions develop context-specific solutions.

Our work to close the gap between actual and potential water and agricultural productivity in the Middle East and North Africa region (MENA) continues to advance, with ongoing projects using geospatial mapping and monitoring. We have moved closer to developing a near-real time, satellite-based evapotranspiration product designed to help the MENA region develop context-specific solutions to water management in agriculture. The University of Nebraska is implementing the technology with funding from USAID, the International Center for Biosaline Agriculture and DWFI, collaborating with colleagues at USDA-ARS Hydrology and Remote Sensing Laboratory, the Earth System Science Interdisciplinary Center at University of Maryland and NASA Marshall Space Flight Center.

The product is based on a modeling approach to estimate daily evapotranspiration or "ET." ET is the movement of moisture from earth's



ALEXI map of MENA region showing evaporative stress

surface to the atmosphere through combined evaporation and plant transpiration. This product is being used by our partners at the NDMC for calculating the Composite Drought Index (CDI) and developing drought early warning tools. These tools will improve drought monitoring and help stakeholders across the water-scarce region better understand how this information can enhance decision-making related to water management. The daily ET product will also be used to estimate total biomass and yield, along with seasonal crop water productivity for different crops in the region. Partnering with the FAO MENA Office in Cairo, we will test and train water users and agricultural entities to use the product and improve water use efficiency.

The information collected from the ET monitoring satellite-based model is processed at UNL's Holland Computing Center to illustrate the moisture content of agricultural areas around the world. The system assesses the need for irrigation and calculates potential and attainable crop yield at multiple levels: farm field, irrigation



The ultimate goal is to expand the data system to other food producing areas in the world and test it in the different climatic regions, making it available online to government agencies, regional and local water managers and agricultural entities.

system, agricultural climate zone and country. Once the present model results are verified with ground data, researchers will make any necessary model adjustments to ensure accuracy.

With accurate information on ET levels, farmers can pinpoint specific areas that may need more, or less, irrigation to achieve maximum yields with the least amount of water added. And, researchers and water managers can better predict and manage drought conditions. The ultimate goal is to expand the data system to other food producing areas in the world and test it in the different climatic regions, making it available online to government agencies, regional and local water managers and agricultural entities.

Nebraska Water Productivity Report nears completion

With limited water resources, we need to increase crop yields by improving water productivity in agriculture. The Nebraska pilot of DWF's new series of Water Productivity Reports shares lessons that may be applied globally to develop water productivity indicators and offer valuable gap analysis to enhance water and food security.

Before we can provide recommendations to farmers on how to optimize their water use in agriculture, we need to first measure the existing conditions and compare them to the maximum potential. This is the intent of the institute's Nebraska Water Productivity Report, a research project in which the institute made significant progress in the last fiscal year.

The research, led by DWF with support from Arjen Hoekstra, professor in water management, University of Twente, The Netherlands, and Faculty Fellows Patricio Grassini and Haishun Yang, develops and tests methodologies to identify gaps between actual and attainable water and energy productivity in Nebraska's crop and livestock production.

The forthcoming pilot report assesses water productivity at farm and state levels, comparing and benchmarking values for four major crops in Nebraska: corn, soybean, sorghum and dry bean. It explains various water productivity definitions and shows the results of developing and testing strategies to improve water productivity in the state, such as the effects of using different irrigation technologies. For three Nebraska Natural Resources Districts (NRDs) where field-level statistical data is available (Central Platte, Tri-Basin, and Lower Niobrara), the report compares the volume of irrigated water farms apply against the irrigated water required. The next phase of the work will focus on assessing the water productivity of livestock production, including beef cattle, dairy cows, pork and poultry; comparing the net energy of ethanol from corn and sugarcane, and measuring the water requirements and carbon footprint of electricity generation in Nebraska.

The report is undergoing formal peer review and is expected to be finalized in 2018. In April, DWF staff presented the preliminary findings at the 2017 Water for Food Global Conference in Lincoln, Nebraska, and at an Indo-U.S. workshop addressing the food-energy-water nexus in Bangalore, India. Once the methodologies and results are vetted within

Nebraska, lessons learned from the pilot will be used to develop other global water productivity indicators and offer gap analysis benefits to other parts of the world.

Global Yield Gap and Water Productivity Atlas expands into Indonesia

Developing the Global Yield Gap and Water Productivity Atlas in Indonesia will help the country identify where significant gaps exist between actual and potential yields, enabling context-specific solutions for water and food security in a country with excellent potential – and need – for improved agricultural productivity.

With ongoing support from DWFI, the Global Yield Gap and Water Productivity Atlas has extended its reach to include Indonesia. The map-based web platform provides robust estimates of untapped crop production potential on existing farmland based on current climate and available soil and water resources. Providing robust estimates of yield potential, yield gaps, and water productivity on Indonesia's major food crops will help the country's researchers, farmers, crop consultants, policymakers and other decision-makers identify areas with the greatest potential to sustainably increase food supply with improved management practices, reducing pressure on threatened natural ecosystems.

The atlas estimates crop yield gaps for major food crops at field, regional and national scales, ranging from subsistence crops in sub-Saharan Africa to high-yield irrigated corn in



the U.S. Data from 51 countries that have been incorporated into the platform since DWFI provided seed funding to initiate the project in 2011. GYGA is led by Faculty Fellow Patricio Grassini, University of Nebraska–Lincoln assistant professor of agronomy, along with Faculty Fellow Haishun Yang, associate professor of agronomy at Nebraska, and colleagues at Wageningen University in The Netherlands. GYGA Indonesia partners include the Indonesian Agency for Agricultural Research and Development, Universitas Indonesia, and the World Bank office in Jakarta. Last year, Grassini helped lead two training workshops at Bogor (West Java) involving 45 Indonesian researchers from across the archipelago.

Upcoming GYGA extensions include Belarus, Iran and Japan. To learn more about the atlas, visit yieldgap.org.

Faculty Fellow Patricio Grassini (holding notebook) meets with GYGA partners in Indonesia in July.

Strategic framework seeks to enhance drought resilience in Africa

Faculty Fellow Tsegaye Tadesse, a research associate professor of applied climatology and remote sensing expert in UNL's School of Natural Resources and the National Drought Mitigation Center, is dedicated to making a difference in the lives of others by informing them about drought risk management and preparedness – particularly in Africa, where there is great vulnerability to water and food insecurity.

Tadesse's current work focuses on developing drought monitoring and prediction tools by using satellite data, climate data, biophysical parameters, land cover, land use, soil and elevation. The tools will help water managers, policymakers and producers make more informed decisions that will reduce drought's harmful effects on economic sectors, communities and ecosystems.

FAO invited Tadesse to consult and develop a white paper on drought risk management and resilience for all of Africa. He helped lead a team of experts to draft the white paper, building on the work of other University of Nebraska researchers, and presented it to African ministers at the first-ever African Drought Conference in Windhoek, Namibia, August 2016.

"We helped put all the national and international experts together and presented it to the ministers so we could convince them to invest in



Faculty Fellow Tsegaye Tadesse (fifth from left) stands with colleagues at the African Drought Conference in Namibia in August 2016.

proactive drought risk management to reduce Africa's vulnerability to drought," Tadesse said. "In Africa, the impact of drought is huge, costing millions of lives for long historical periods."

Addressing drought-related issues is more important now than ever, said Tadesse, as drought is expected to increase in frequency in the future. This, along with increasing population in Africa, means that drought will continue to have negative impacts in Africa and elsewhere.

Tadesse and the other multi-disciplinary experts at the NDMC work to leverage Nebraska's knowledge and experience

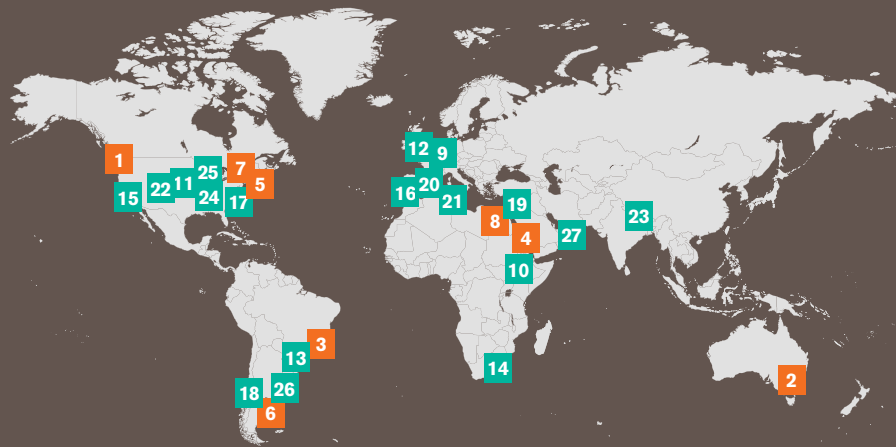
to help the nation and the world, a main objective of the DWFI, but there is also much to learn from others.

"We learn a lot from Africa," said Tadesse. "It is important for them to help us understand the issue of drought from their perspectives, learning from their experience and ways of coping."

Gaining approval from the African ministers was the first big step, said Tadesse. The next steps are to secure the financial resources to implement the plan and tailor it for individual countries – no easy feat.

GLOBAL FELLOWS AND INTERNATIONAL ADVISORY PANEL MEMBERS

Connecting Nebraska to the World



INTERNATIONAL ADVISORY PANEL

1. **Margaret Catley-Carlson**
Vice Chair, Canadian Water Network; Vancouver, Canada
2. **Colin Chartres**
Director of Training and Master Classes, Crawford Fund, Australia; Adjunct Professor, Institute of Applied Ecology, University of Canberra; Australia
3. **Marcos Folegatti**
Professor of Biosystems Engineering, University of São Paulo; São Paulo, Brazil
4. **Bashir Jama**
Division Manager, Agriculture and Food Security Division, Islamic Development Bank; Jeddah, Saudi Arabia
5. **Uma Lele**
Independent Scholar and Development Economist; Washington, D.C., USA
6. **Martin Pasman**
President, Valmont Industries de Argentina; Buenos Aires, Argentina
7. **Peter Rogers**
Gordon McKay Research Professor, School of Engineering and Applied Sciences, Harvard University; Cambridge, Massachusetts, USA

8. **Pasquale Steduto**
Deputy Regional Representative for the Near East & North Africa Region, Food and Agriculture Organization of the United Nations; Cairo, Egypt

GLOBAL FELLOWS

9. **Wim Bastiaanssen**
Water Resources Analyst and Remote Sensing Specialist, IHE Delft; The Netherlands
10. **Shimelis Beyene**
Consultant; Addis Ababa, Ethiopia
11. **George Burba**
Principal Scientist and Tech Group Leader, R&D, LI-COR Biosciences Graduate Adjunct Professor, SNR; University of Nebraska–Lincoln, USA
12. **Adrian Butler**
Reader in Subsurface Hydrology, Department of Civil & Environmental Engineering, Imperial College London; United Kingdom
13. **Antonio Heriberto de Castro Teixeira**
Embrapa Satellite Monitoring, Campinas – Sao Paulo; Brazil
14. **Colin Everson**
Hydrometeorologist, South African Earth Observation Network; Pietermaritzburg, South Africa
15. **John Gates**
Senior Hydrologist, Climate Corporation; San Francisco, California, USA
16. **Helena A. Gomez Macpherson**
Tenure Researcher, Instituto de Agricultura Sostenible; Córdoba, Spain
17. **Christopher Hain**
Assistant Research Scientist, Earth System Science Interdisciplinary Center, University of Maryland, NOAA Center for Weather and Climate Prediction; College Park, Maryland, USA
18. **Luis Octavio Lagos**
Department Head, University of Concepción, Agricultural Engineering School, Water Resources Department; Chillán, Chile
19. **May Massoud**
Associate Professor, Department of Environmental Health, Faculty of Health Sciences, American University of Beirut; Beirut, Lebanon
20. **Luciano Mateos**
Research Scientist, Institute for Sustainable Agriculture, Spanish National Research Council (CSIC); Córdoba, Spain

21. **Thuraya Mellah**
Researcher and Lecturer, Manouba University; Tunisia
22. **Gary P. Merkle**
Irrigation, Water Resources, and Hydraulic Engineer; Ft. Collins, Colorado, USA
23. **Aditi Mukherji**
Theme Leader for Water and Air, International Centre for Integrated Mountain Development; Kathmandu, Nepal
24. **Juan Pablo Sesmero**
Assistant Professor, Agricultural Economics, Purdue University; West Lafayette, Indiana, USA
25. **Jeffrey M. Peterson**
Director, Water Resources Center, University of Minnesota; St. Paul, Minnesota, USA
26. **Federico Garcia Suarez**
Assistant Professor, University of the Republic, School of Agronomy, Social Sciences Department; Montevideo, Uruguay
27. **Slim Zekri**
Associate Professor, Department of Natural Resource Economics, CAMS, Sultan Qaboos University; Oman

2017 FACULTY FELLOWS

AGRICULTURE



P. Stephen Baenziger

Agronomist and Wheat Breeder

Guillermo Baigorria

Crop Simulation Modeler

Vijendra Boken

Remote Sensing & Water Resources Expert

Edgar Cahoon

Plant Geneticist

Kenneth Cassman

Agronomist

Dean Eisenhauer

Irrigation Engineer

Roger Elmore

Cropping Systems Agronomist

Roch Gaussoin

Agronomist

Patricio Grassini

Cropping Systems Agronomist

Derek Heeren

Irrigation Engineer

Adam Liska

Biological Systems Engineer

Martha Mamo

Soil Scientist

Derrel Martin

Irrigation and Water Resources Engineer

Teshome Regassa

Agronomist

Daran R. Rudnick

Irrigation/Water Management Specialist

Daniel Schachtman

Plant Molecular Physiologist

James Schnable

Irrigation/Water Management Specialist

Tim Shaver

Nutrient Management Specialist

Jayne Stratton

Food Microbiologist

Harkamal Walia

Plant Molecular Physiologist

Bing Wang

Human Health Risk Analyst

Charles Wortmann

Agronomist

Haishun Yang

Crop and Ecosystem Modeler

ENVIRONMENT



Craig Allen

Wildlife Ecologist

Tala Awada

Plant Ecologist

John Carroll

Wildlife Ecologist

Trenton Franz

Hydrogeophysicist

Sherilyn Fritz

Paleoclimatologist

Brian Fuchs

Climatologist

John Gamon

Remote Sensing Expert

Troy E. Gilmore

Groundwater Hydrologist

Priscilla Grew

Geologist

Michael Hayes

Climatologist and Atmospheric Scientist

Ayse Kilic

Remote Sensing Expert

Alan Kolok

Aquatic Toxicologist

Jesse Korus

Groundwater Hydrologist

Aaron Mittelstet

Watershed Hydrologist

Francisco Muñoz-Arriola

Hydroinformaticist

Robert Oglesby

Climate Modeler

Christine Reed

Public and Environmental Policy Analyst

Clinton Rowe

Meteorologist and Climatologist

Pat Shea

Environmental Chemist

John (Jack) Shroder

Micrometeorologist

Andrew Suyker

Micrometeorologist

Mark Svoboda

Climatologist

Tsegaye Tadesse

Climatologist

Steve Thomas

River/Stream Ecologist

Elizabeth VanWormer

Epidemiologist

Brian Wardlow

Remote Sensing Expert

Don Wilhite

Climatologist

Wayne E. Woldt

Environmental Engineer

Vitaly Zlotnik

Hydrologist

Art Zygielbaum

Remote Sensing Specialist

HEALTH, SCIENCE & ENGINEERING



David Admiraal
Environmental Engineer

Ozgur Araz
*Systems Scientist and
Business Analyst*

Lorena Baccaglini
Epidemiologist

Shannon Bartelt-Hunt
Environmental Engineer

Andrea Erin Bass
Business Analyst

Paul Black
Biochemist

Mohamed Dahab
Environmental Engineer

Carrick Detweiler
*Computer Scientist
and Robotician*

Concetta DiRusso
Biochemist

Bruce Dvorak
Environmental Engineer

Yufeng Ge
*Advanced Sensing
Systems Engineer*

James Goedert
Construction Engineer

Junke Guo
Environmental Engineer

Christopher Gustafson
Behavioral Economist

Xu Li
Environmental Engineer

Yusong Li
Environmental Engineer

Pinaki Panigrahi
*Epidemiologist and
Pediatrician*

Helen Raikes
*Child Development and Early
Education Specialist*

Eleanor Rogan
*Public and Environmental
Health Expert*

Ashok Samal
Computer Scientist

Mehmet Can Vuran
*Computer Scientist and
Electrical Engineer*

Karrie Weber
Microbiologist

POLICY AND SOCIAL SCIENCE



J. David Aiken
*Water and Agricultural Law
Specialist*

Simanti Banerjee
*Behavioral and Environmental
Economist*

Jean Cahan
*Religious and Historical
Philosopher*

Judy Diamond
Science Literacy Educator

Michael Farrell
Documentary Filmmaker

Cory Forbes
Science Literacy Educator

Michael Forsberg
*Wildlife Photographer
and Ecologist*

Lilyan Fulginiti
Agricultural Economist

Roberto Lenton
*Global Water Management
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**IMPROVING GROUNDWATER
MANAGEMENT FOR
AGRICULTURAL PRODUCTION**



JOSHUA REDWINE

Addressing the sustainability of the U.S. High Plains Aquifer

The U.S. High Plains Aquifer provides household water supply for millions of people living in Nebraska and parts of seven other states. But, more than 90 percent of the water pumped from the aquifer is used for irrigated agriculture. We must find ways to advance our understanding of groundwater management to share knowledge with others and ensure this vital resource is available for future generations.

The NWC and DWFI are contributing to a consortium working to address sustainability concerns for the High Plains Aquifer, where groundwater is heavily used for food production. “Sustaining Agriculture through Adaptive Management Resilient to a Declining Ogallala Aquifer and Changing Climate” is funded through the USDA National Institute of Food

and Agriculture and led by Colorado State University. The NWC leads the University of Nebraska’s effort in the consortium, which was awarded \$1 million out of the \$9.6 million grant.

The project uses a comprehensive approach that integrates management strategies to improve water use across the region. The expected outcomes of the four-year project, which began in 2016, are to help farmers and decision-makers better understand the challenges of water scarcity they will face in the future, and identify policy and management responses that will most effectively increase sustainability and reduce conflict over limited water resources.

Among other objectives, the team is gathering hydrologic and crop water use data, which can be used to manage pumping rates. They are developing a comprehensive, aquifer-wide hydrologic model as an important baseline tool to estimate climate change and management impacts on groundwater levels across the region.

Storm clouds gather over a Nebraska farm field.



They are developing a comprehensive, aquifer-wide hydrologic model as an important baseline tool to estimate climate change and management impacts on groundwater levels across the region.

In the past year, researchers with DWFI, NWC and partner institutions created and linked models of surface water, groundwater and crop growth for the U.S. High Plains region. Models are being produced for watersheds in Nebraska, Colorado, Kansas and Texas to develop localized solutions and find new approaches at appropriate scales for improved management and decision-making.

DWFI/NWC graduate and postdoctoral researchers are part of the Nebraska team, assessing water table variations in response to climate change and cropping system variabilities, and conducting crop growth and yield simulations based on current and future climatic scenarios. Learn more about the project at ogallalawater.org.

GRIPP initiative promotes collaboration, groundwater solutions

DWFI is contributing to a global partnership for sustainable groundwater management, leveraging the institute's leadership and expertise to develop new collaborations on groundwater research and policy that support future water and food security.

DWFI is a core partner in the Groundwater Solutions Initiative for Policy and Practice (GRIPP), a global partnership for sustainable groundwater management led by the International Water Management Institute (IWMI). In February, DWFI participated in the first partners' meeting, held in Geneva,

Switzerland, to develop new collaborations on groundwater research and policy. Discussions focused on potential joint activities and the expected outcomes and impacts to advance the GRIPP initiative, as well as how best to leverage existing resources. DWFI's activities within GRIPP will serve to identify and translate best practices for groundwater management, with a longer-term goal of positively influencing governance and policy. In follow-up to the inaugural meeting, the group is generating impact pathways and a list of activities and outputs for 2017. Learn more about the initiative at gripp.iwmi.org.

Brazil partnership aims to increase irrigation productivity, farmer income

DWFI and the University of Nebraska are working to help Brazil sustainably increase its irrigation productivity through water productivity analysis and crop modeling, as well as establishing groundwater governance policies and effective water management practices.

DWFI is working with partners in Brazil where the main crops are similar to Nebraska: corn, soybeans and dry beans. Despite similar geographies, the weak Brazilian currency and high inflation rate, propelled by a volatile political environment, creates challenges for Brazilian farmers – especially smallholders. There is tremendous potential to raise agricultural production in Brazil by increasing irrigation efficiency — an area where Nebraska

excels. There is also a significant risk of groundwater and ecosystems degradation if the resources are not effectively developed and managed.

This year, the institute entered a new partnership with the Association of Irrigators and Farmers of the State of Bahia, Brazil (AIBA). Other partners are the Federal University of Vicosa, Minas Gerais, Brazil; and the State Government of Bahia. The goal of this partnership is to support the sustainable expansion of irrigated agriculture in southwest Bahia, exploring the region's Urucuia Aquifer System as the water source. Currently, all the pressurized irrigated agriculture in the region, mostly center pivot irrigation, is supplied by surface waters from multiple rivers. Preliminary estimates indicate the potential for at least an additional 300,000 hectares of irrigated agriculture, which would promote economic growth and development in the region.

The research team is working to quantify the Urucuia Aquifer's potential for additional sustainable irrigation through modeling flows and recharge in the system; collaborating with the State Government of Bahia to develop a new system of sustainable and flexible groundwater governance, along with local monitoring and control; and developing a groundwater monitoring system to track the aquifer as pumping ensues in the future. Federal University of Viçosa is presently conducting the groundwater modeling. DWFI will provide guidance on the groundwater monitoring and governance aspects using Nebraska's rich experience in this area.

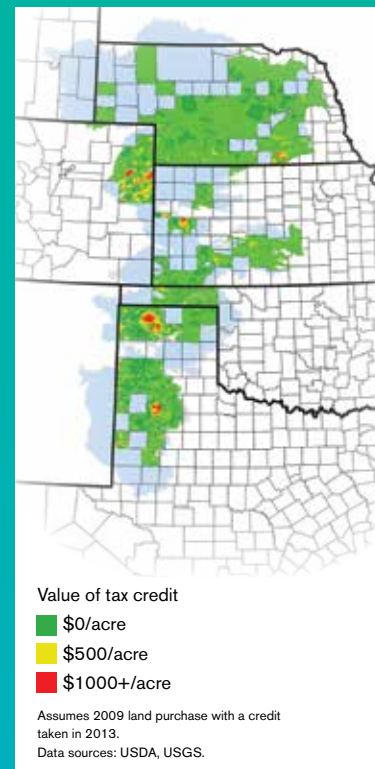
Policy Brief: "Paid to Pump"

The institute developed its first policy brief, examining an unusual federal tax credit for aquifer depletion that might discourage conservation of the High Plains Aquifer.

DWFI staff learned of a decades-old policy that provides water users in parts of eight High Plains states a tax credit for depleting groundwater -- the more an aquifer is depleted locally by a water user, the larger the credit that can be claimed.

The policy stems from a 1965 decision, *United States vs. Shurbet*, which entitled irrigators using groundwater in areas of Texas and New Mexico to a cost depletion tax credit due to the "peculiar" conditions in the area. The findings of the *Shurbet* case were intended to be limited to the southern High Plains region but in 1980, a lawsuit against the IRS expanded the entitlement to include all landowners extracting groundwater from the approximately 174,000 square miles of land overlying the High Plains Aquifer. Currently, the estimated value of the credit is highest in parts of northern Texas, eastern Colorado, western Kansas and south central Nebraska.

Student interns researched the issue, producing a four-page policy brief on the tax credit, its possible implications for aquifer depletion and how changing the policy could



Source: [Drops and Crops](#), part of DWFI

support agriculture and water conservation.

A news outlet contacted DWFI to get a policy perspective on the issue. The resulting article garnered further media publicity, bringing attention to the need for effective water governance and elevating public awareness of the issue and the institute's expertise in water policy research.



**ENHANCING HIGH
PRODUCTIVITY IRRIGATED
AGRICULTURE**

Understanding effective water resource management to inform policy development and drive behavior change

DWFI's water resource economics and policy research and engagement helps researchers, farmers, practitioners and others better understand the human and natural dynamics of groundwater systems and informs decision-making to conserve scarce water resources.

Over the past year, the institute has continued to build upon its work in water resource economics and policy with research and outreach on the economic, hydrologic and ecologic impacts of groundwater-fed irrigation. Projects include launching AquaCrop-OS, an open-source crop simulation model that provides researchers with a state-of-the-art tool to improve irrigation decision-making and policy analysis; developing a report on best practices for groundwater management with the Environmental Defense Fund; and hosting a national agricultural water management meeting, in which DWFI shared Nebraska's groundwater expertise with water resource economists from around the U.S.

Mathematical models that simulate how crops respond to water are powerful tools for addressing water and food security challenges. However, the data from these models are only valuable if they are easily and widely accessible to researchers and others who can use it with other water management software



and data. DWFI has helped provide a solution to this problem by developing AquaCrop-OS. The software tool is a free and open-source version of AquaCrop, a crop water productivity model produced by FAO in 2009. Farm managers, policymakers, researchers and other practitioners can use the tool for water use decision-making from field to basin scales. DWFI convened the AquaCrop-OS development group, worked closely with FAO to ensure the tool's accuracy and gained FAO's support for making it widely available.

DWFI launched AquaCrop-OS during 2016 World Water Week in Stockholm, along with partners FAO, the University of Manchester and Imperial College, London. The first workshop for AquaCrop-OS was held during the 2017 Water for Food Global Conference and attracted an overcapacity audience of researchers and students interested in learning

The inaugural AquaCrop-OS workshop was held during the 2017 Water for Food Global Conference.

how to use the tool. The software has been downloaded more than 550 times from more than 85 countries. To learn more about the software, visit aquacropos.com.

The institute also worked closely with the Environmental Defense Fund (EDF) to identify and improve knowledge of best practices and cost effective groundwater management. The partnership team conducted research on best



management practices for incentive-based groundwater management in the Western United States. The project goal was to develop case studies on best practices for incentive-based groundwater management, taking into account local context and climate. The case studies, which draw from Arizona, Colorado, Nebraska, Oregon and Texas, are featured

in a joint EDF/DWFI report that describes the key challenges and solutions identified for successfully managing groundwater resources. The report explores various types of management and identifies major themes of successful groundwater management:

- ▶ Building trust
- ▶ Collecting data
- ▶ Using a suite of tools
- ▶ Monitoring and enforcement
- ▶ Funding

The report will provide groundwater managers in California and other Western states with practical, real-world examples of effective groundwater management strategies. It has the potential to influence legislation, such as California's new Sustainable Groundwater Management Act. View the report on the [DWFI website](#).

Increasing agricultural yields through precise Variable Rate Irrigation

A new project combines the University of Nebraska's expertise in variable rate irrigation, unmanned aircraft technology and satellite-based remote sensing to inform agricultural decision-making, resulting in more precise center pivot irrigation and cost savings.

For generations, Nebraska farmers have optimized their water use through irrigation scheduling. In recent years, variable rate irrigation (VRI) – which matches the water



application rate of center pivots to specific areas of a farmer's field that need more or less water – has garnered attention as a way to optimize water use and yields. VRI can help minimize pumping energy costs, lower the frequency of malfunctioning pivots due to over irrigation, avoid chemigation over non-cropped areas, reduce runoff and decrease nitrate leaching. Unmanned aerial vehicles (UAVs or drones) are another technology that researchers and farmers are using to collect crop data and evaluate in-field stress in specific areas, leading to greater precision in center pivot irrigation.

DWFI is co-leading a [project](#) with Faculty Fellows Wayne Woldt and Derek Heeren, both biological systems engineers at Nebraska, to leverage the university's expertise in VRI, drones and remote sensing technology

to help farmers increase food production, while conserving water and energy, using a combination of soil water content monitoring, remote sensing from drones and satellite systems and modeling.

The researchers have conducted tests at the Eastern Nebraska Research and Extension Center (ENREC) and at the West Central Water Resources Field Laboratory near Brule, Nebraska.

This research began in 2015 with a relatively small project with goals to capture real-time, remotely sensed multispectral imagery over large-scale row crop systems with a drone equipped with a triple sensor system. The researchers integrated the remotely sensed data into a simulation model to evaluate

Members of the Nebraska unmanned aircraft research team (left to right): Joe Luck, Christopher Neale, Wayne Woldt, George Meyer, Derek Heeren and Yufeng Ge.



Researchers developed a protocol to successfully deploy the drone and capture near real-time, remotely sensed high-resolution imagery on at least a weekly basis.

soil water content and ET. These data help researchers make prescriptions for effective VRI management.

Research activities have focused on developing a sensor system for the fixed wing airframe, and conducting flight operations at ENREC. Researchers developed a protocol to successfully deploy the drone and capture near real-time, remotely sensed high-resolution imagery on at least a weekly basis.

In addition, the research team used the drone captured images to generate a vegetation index image for the entire field. The team also developed protocols and procedures for processing the drone imagery so it can be used in the simulation model.

DWFI supported two future leaders in this research area, doctoral student Burdette Barker and MSc student Mitchell Maguire, both within UNL's Department of Biological Systems Engineering. Barker received his doctorate in May 2017 and is now a post-doctoral scholar. He was one of only three UNL students awarded a 2016-17 presidential graduate fellowship in recognition of his high scholastic performance and personal accomplishment.

The research team was awarded a \$500,000 USDA NIFA grant to further develop this innovative research to help farmers increase crop production through precise VRI management.

World Bank water assessment in the Dominican Republic

This effort combines the geospatial, hydrological and climate modeling expertise of DWFI and its Faculty Fellows to provide an assessment of water availability in two watersheds of the Dominican Republic as an important step in effectively advancing water and food security research in this country.

DWFI has worked closely with the World Bank on a number of projects related to water and food security in the last fiscal year. A particularly promising development is a new joint project supporting the World Bank's Water and Agriculture Global Solutions Group on water resources management, and agricultural landscapes (both rainfed and irrigated agriculture) in the Dominican Republic. The project will develop a geospatial database to



Christopher Neale with colleagues at the Indrhi República Dominicana in February 2017.

help assess the challenges and prioritize actions for a new World Bank-funded investment program in the Yaque del Norte and Osama-Isabela watersheds. This joint project enables DWFI to extend its reach to the Dominican Republic, applying our tools and expertise to support the planning and implementation of on-the-ground investments in improving water security and sustainably increasing agricultural productivity in these watersheds.

DWFI is preparing a geospatial database including various information layers: watershed and sub-basin boundaries; rivers; reservoirs; weather stations and river gauging stations; natural resources protected areas; soil suitability for irrigation and other soil related information; provinces, municipalities and urban areas; irrigated areas and related water user associations; and irrigation canal systems. In addition, the team will classify the land surface types and vegetation within the watersheds based on recent Landsat satellite imagery and ground-truthing made available with high-resolution color photography.

The team also includes researchers from IHE Delft Institute for Water Education (formerly UNESCO-IHE), led by DWFI Global Fellow Wim Bastiaanssen. IHE Delft will conduct a water accounting exercise that estimates the watersheds' water balance in phase two of the project.

The outputs of this research will guide the design of future investments in the watersheds, including conservation practices and sustainable agriculture development.

CIRCLES irrigation project takes shape in Tanzania

Improving access to high productivity irrigation equipment and training in sub-Saharan Africa can make a difference, not only in food production, but in quality of life for millions of smallholder farmers. The CIRCLES pilot project could be the beginning of several similar projects resulting in on-the-ground impact around the world.

Commercial farmers in Africa achieve 4-10 times the yields of neighboring smallholder farmers. Why are commercial farmers in Africa doing so much better? Effective irrigation, and the infrastructure that makes irrigation possible, is an important component of achieving high agricultural productivity.

Most smallholder farmers are at the mercy of unpredictable rainfall, have limited connections to markets, lack access to financing to invest in new technology, access and rights to water, and have tenuous tenure on small plots that are in many cases shrinking due to inheritance customs.

Irrigation in agriculture has tremendous potential to increase crop yields, reduce poverty and improve health in sub-Saharan Africa, where nearly one-third of the population still suffers from hunger. However, ensuring long-term food security requires more than putting center pivots on the ground. A successful irrigation system requires strong partnerships, market support, technical training and local engagement.

DWFI is part of an international consortium leading a pilot project to help improve the livelihoods of smallholder farmers in sub-Saharan Africa. CIRCLES, aptly named



Irrigation in agriculture has tremendous potential to increase crop yields, reduce poverty and improve health in sub-Saharan Africa, where nearly one-third of the population still suffers from hunger.



DWFI Executive Director Peter G. McCornick (second from left) and DWFI Director of Policy Nick Brozović (third from left) discuss center pivot irrigation with community members in Dodoma, Tanzania.

for the irrigation technology that dots vast stretches of farmland elsewhere in the world, brings the efficiency of this largescale farming staple to smallholder farmers in the Dodoma region of Tanzania, plus the training, equipment and infrastructure needed to help farmers be successful. The overall goal of the CIRCLES project is to raise smallholder farmers' household income by increasing their agricultural production through technology adoption, access to financing, market linkage and institutional support.

In February, a public-private delegation from Nebraska visited Dodoma at the invitation of the regional government. The group evaluated two potential sites, selected and offered by the regional government, for the pivot installation. They also had discussions with various partners to continue developing the activities and timeline of the project.

The visit yielded new partners in the project: the Chamwino District Council, Dodoma Regional Secretariat and the University of Dodoma. WorldServe International has also joined as an in-country partner. A formal Memorandum of Understanding is being finalized with input from all partners.

The potential field site is located within the Mvumi Makulu area. DWFI Research Associate Lameck Odhiambo spent most of July 2017 in Tanzania overseeing the project on the ground – conducting soil sampling and a hydrological survey, demarcating farm boundaries, assessing groundwater resources and obtaining a well drilling permit. The center pivot equipment is in storage, the community has begun to clear bushes and trees, and local partners and Odhiambo are educating the community and farmer cooperatives.

Once the MOU is completed, WorldServe International will begin drilling boreholes at the site to test the groundwater aquifer potential for center pivot irrigation.

The CIRCLES project has the potential to have a significant impact on the health and livelihoods of villagers by addressing the root cause of poverty: lack of income. This collaborative, market-based approach could not only enhance water use efficiency and agricultural productivity — but also transform lives by providing tools to help end the cycle of poverty.

Data in irrigated agriculture: Using smart water meters to improve water and energy efficiency

A partnership between DWFI and Smart Water Metering will use data collected from field-level sensor networks to help farmers benchmark and improve their energy efficiency, leading to more sustainable natural resource management.

Field-level data collection in agriculture has grown enormously during the last few years. Data are collected from farmer-produced surveys, from field-level sensor networks, as well as from remote sensing and other public and private sources. Such data have the potential to revolutionize our understanding of agricultural production and of the food-energy-water nexus.

DWFI has partnered with Smart Water Metering, a Canadian startup company



that develops smart meters for agricultural applications, to launch a pilot program with irrigators to install 200 smart meters on electric groundwater pumps by the end of FY18, and to help those irrigators benchmark and improve their energy efficiency. SWM is providing its meters at a significant discount below production costs. DWFI is providing field and analytical expertise and has contributed to meter design and development.

This year the team completed sensor design and certification, and negotiated a data plan to allow data acquisition from the sensors. Fifty installation sites were identified in Nebraska and the remainder will be identified by the end of 2017. SWM is manufacturing the smart meters, which are due for delivery in November and will be installed over the winter and spring. The longer-term goal of this project is to influence wide-scale adoption of technology and best practices to improve water and energy use in agriculture.

Program Coordinator Kate Gibson (left) and Program Associate Morgan Spiels recruit participants in the smart meter pilot project during Husker Harvest Days 2017.

Nebraska farm database harnesses 'big data' to inform decision-making

In the past few years, "big data," the use of aggregated data systems to analyze trends, reached the world of agriculture, and an enormous amount of farm data now exist. However, collecting and analyzing the data to help make better decisions is no easy task.

Researchers from DWFI and UNL's Department of Agronomy and Horticulture are collaborating with students from UNL's Jeffrey S. Raikes School of Computer Science and Management to help make field-level data more useful and widely available by developing a farm management database for Nebraska. The database is an online portal with analytics tools to help Nebraska producers, managers, and researchers make informed decisions to improve agricultural productivity using fewer inputs. The website creates a central location for agricultural data to be entered and maintained confidentially, offering access to the largest publically available producer field database in the world. The data can be used to benchmark farmers' production with anonymized peer groups, improve crop management decisions, enhance technical innovations and guide agronomic research.

A team of six students in the Raikes School's Design Studio program gathered feedback from target user groups: agricultural producers, representatives from Nebraska's NRDs



Students from the University of Nebraska–Lincoln's Raikes School of Computer Science and Management present the farm database project at the 2017 Water for Food Global Conference.

and state-level management groups, and university researchers, to develop a user-friendly website database. The database meets the unique needs of all three groups. For example, academic researchers will be able to import and export anonymized data safely and easily, allowing them to further their research around the world without compromising confidentiality. Agricultural producers can use the system to identify resource management efficiency within their operations and anonymously benchmark their fields to those of producers in the same region or producers with similar weather and soils.

The Design Studio team began developing the database in the fall 2016 term, and presented it at the 2017 Water for Food Global Conference in April. In June, DWFI staff presented the pilot project results at the Agricultural Economic and Technology Summit in Kearney, Nebraska.

DWFI has assembled a new student team that will continue developing the project through the fall 2017 term. Goals for the coming year are to integrate spatial data and real-time data into the system and to work more extensively with the first group of NRDs to develop a dashboard that meets their data management and analysis needs.



Irrigation Specialist Lameck Odhiambo (left) speaks with a farmer in Dodoma, Tanzania.



**FRESHWATER AND
AGRICULTURAL ECOSYSTEMS
AND PUBLIC HEALTH**

Water Frontiers: Expanding water markets in the U.S.

Environmental markets are a growing policy approach with the potential to improve water use and drought-risk management. DWFI is working closely with the USDA to understand existing water markets and influence new water market adoption – a new frontier in water management.

Drought is a worldwide problem, causing substantial losses to agriculture and the economy at large. While water markets and market-like transactions are held up as a cost-effective solution to manage scarcity, there are many misconceptions about the design and implementation of water markets, as well as their efficiency and equity, by both academics and practitioners. The institute is poised to be a thought leader in this emerging area, with a wealth of expertise and experience to share, which can lead to positive impacts on the environment and livelihoods.

Water trading refers to the lease, sale or exchange of water or water rights between willing participants. Water transactions occur through a variety of structures, including bilateral contracts, auctions, bulletin boards, and algorithmic clearinghouses. Water markets can be leveraged for many purposes by many users, including agricultural, environmental, industrial and municipal entities. While there is great potential to expand water markets in the U.S., research and education are needed on how to effectively develop and monitor them. DWFI's goal for its water market collaborations is to help improve agro-ecosystem health

and rural economies through influencing the adoption of water markets.

DWFI worked with the USDA Office of Environmental Markets and with Mammoth Trading, a startup company specializing in water markets, to understand the role of informal water transactions in the Western U.S. Informal water markets are widespread and provide significant drought risk mitigation to agricultural producers. However, they have generally been ignored in the policy debate. The research is focused on understanding the range of transaction types operating now, and how they can be transferred or adapted to other contexts. A report on research results will be published in 2018.

Building on a successful 2015 workshop on water quality trading held jointly by DWFI, USDA, and the Environmental Protection Agency (EPA), DWFI worked with the USDA Office of Environmental Markets to produce a markets workshop for participants at the 2017 Water for Food Global Conference. Held in partnership with NDMC, "Water Frontiers" offered four different sessions that explored market-based approaches to improving water use for drought risk management.

The session speakers, all water market experts, helped advance knowledge on the challenges and opportunities in various water market scenarios: establishing Australia's water markets; riparian water markets in Alabama; formal and informal water markets for drought risk management; the role of transaction costs in water markets; water transactions



DWFI's goal for its water market collaborations is to help improve agro-ecosystem health and rural economies through influencing the adoption of water markets.

for groundwater management; the legal outlook for water transactions; and the role of new tools and technologies in facilitating water transactions. Videos of the sessions are available on DWFI's YouTube channel.

Improving Nebraska's water quality by studying the vadose zone

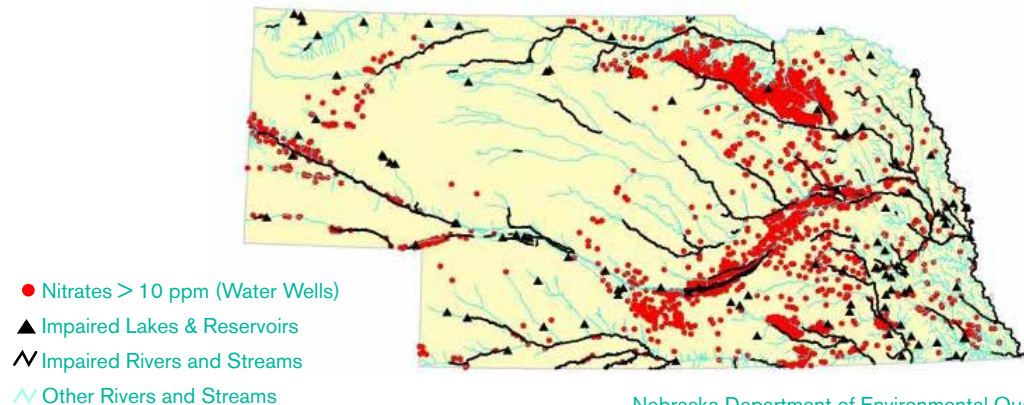
Through research to better understand how chemicals used in agriculture influence water quality, DWFI and NWC are working to support the adoption of agricultural practices that minimize negative impacts on water quality in Nebraska, the U.S. and the world.

Nutrient leaching agriculture remains a concern for many communities in Nebraska, whose water supply contains elevated nitrate

levels, creating consequences for ecosystem and public health. The NWC continued to coordinate research with faculty across the University of Nebraska system to develop a deeper understanding of the state's water quality, specifically targeting the shallow vadose zone, or unsaturated zone, to gain insights on how chemicals used to improve agricultural production accumulate and move through groundwater. The researchers are gathering and assessing data to help cities and NRDs learn how to manage this contamination while not adversely affecting agricultural production.

Projects include a study investigating the prevalence and travel routes of nitrate-nitrogen in the Hastings, Nebraska, area and projects funded by the state's Central Platte and Lower Platte South NRDs comparing nitrate levels in the soil and other agrochemicals to previously recorded levels.

NEBRASKA NITRATE CONCENTRATION MAP



Nebraska Department of Environmental Quality, 2014

These vadose zone projects have received funding by the Nebraska Department of Environmental Quality and the Nebraska Environmental Trust to construct a GIS indexed database to help track movement of nitrate across the state to better monitor and predict the state's changing ground water quality.

NET is also funding vadose zone research on the leaching potential of a suite of chemicals used in Nebraska. Color maps in a GIS platform will show if a compound will have likely, unlikely, or uncertain behavior to leach into groundwater. This project will integrate historical and ongoing monitoring studies to project future nitrate contamination by collecting and combining data from previous and current studies and creating a database, website, and GIS map.

With better understanding of how and how much agricultural chemicals are leaching into soil and groundwater, the better we can develop tactics to prevent and mitigate contamination, protecting public health and the environment.

Water for Food Processing Initiative holds potential to improve water and food security

DWFI's new Water for Food Processing Initiative, in partnership with UNL's Food Science and Technology Department, shines a spotlight on the need for better water conservation in food processing as a way to reduce or eliminate waste in food, water and energy.



Food processing uses water in many phases of production. Dairy is one food in particular where processing creates useful by-products, such as whey, that can be a source for water reconditioning, enabling the private sector to take advantage of every drop. Finding new methods for water reconditioning to increase water conservation, treatment, and reuse in food processing is a growing research area that has potential to improve water and food security, as well as the food industry's bottom line.

DWFI has invested in a new Water for Food Processing Initiative to help the private sector optimize water use in food processing and reduce waste in food, water and energy. In April, Yulie Meneses, agro-industrial engineer, joined DWFI as a water for food processing specialist, bringing her valuable expertise in this

University of Nebraska–Lincoln graduate research assistant Xinjuan Hu (left) and Water for Food Processing Specialist Yulie Meneses examine the effect of algae treatment on nutrient removal from food processing wastewater.



Participants in the second class of the WARI fellowship program visit the Hastings Utilities headquarters in Hastings, Nebraska, USA.

relatively new research field. Meneses works jointly with the institute and the University of Nebraska–Lincoln’s Department of Food Science and Technology to improve water and energy conservation and reduce waste in food processing operations.

Two graduate students are also working for the Water for Food Processing Initiative. Xinjuan Hu is a doctoral student working on the project, “Microalgae Treatment of Meat Processing Wastewater for Nutrient Removal and Water Reconditioning.” Carly Rain Adams is a master’s student working on the project, “Energy-Water Reduction and Wastewater Reclamation in a Milk Processing Facility.”

The research area is broad and there are many ways to explore and expand on it. Meneses has submitted several proposals to support various aspects of the research, including to the National Pork Board, Alliance for Advanced Food Sanitation, U.S. Agency for International Development — Partners in Food Solutions and the Nebraska Beef Council.

WARI fellowship program enters second year

Water Advanced Research and Innovation (WARI) fellowship program participants conduct pioneering research in water quality, while sharing knowledge and resources to help the University of Nebraska and Indian institutions address pressing water challenges, building capacity to improve water quality and develop tomorrow’s water leaders.

DWFI has built and enhanced the Water Advanced Research and Innovation (WARI) Fellowship program, now in its second year. The program’s new class features five postdoctoral fellows and six PhD student interns from some of India’s most prestigious research institutions. The new cohort began arriving to the University of Nebraska–Lincoln in June.

WARI is a joint initiative of the institute, the University of Nebraska–Lincoln, Indian Department of Science and Technology, the government of India and the Indo-U.S. Science and Technology Forum.

Through this prestigious and competitive program, accepted scholars visit Nebraska for three to 12 months of hands-on training and mentorship. The participants are matched with faculty mentors to learn cutting-edge techniques and methodologies for today's pressing water problems. The ultimate goal is to equip the scholars, upon returning home to India, with the tools and expertise necessary to tackle some of India's most challenging water problems.

The reciprocal exchange of UNL scholars to India was initiated in the summer of 2017. The selection committee awarded two doctoral students, David Gosselin of the UNL Department of Political Science and Zablon Adane of the UNL Department of Earth and Atmospheric Sciences, with scholarships to research water quality projects with mentors in India.

To facilitate interaction among the participants, the institute hosts monthly lunch and learn events where the participants discuss and exchange research developments. Other events throughout the year facilitate networking and knowledge sharing among the WARI participants, faculty mentors and students.

The program is fostering advanced understanding of water quality and building capacity for water research and leadership. Learn more about the program at waterforfood.nebraska.edu/wari.

2016 World Water Week: Role-playing how water markets improve food security and the environment

DWFI helped organize an interactive session at 2016 World Water Week in Stockholm with the goal to advance knowledge of water markets and how they can be used as a tool to improve water use and food security. Participants learned the fundamentals of water transactions, with most of the session dedicated to giving participants the opportunity to try it themselves, auction paddles in hand.

"Role-Playing How Water Markets Improve Food Security and the Environment" was co-convened by DWFI, Mammoth Trading and the Rockefeller Foundation. Co-leader Nick Brozović, DWFI director of policy, discussed the global problem of drought. Co-leader Richael Young, Mammoth Trading president and former DWFI program associate, explained the various ways water transactions take place. Fred Boltz with the Rockefeller Foundation emphasized the importance of integrating geophysical and social sciences with business, environmental and legal issues in water transactions.

In the interactive demonstration, each participant was designated as a buyer or seller and made decisions about how much water to trade and for what price, all while ensuring environmental goals could be met. The session illustrated the importance of market design to determining both the fairness of trading and the kinds of outcomes that can be reached.



Session attendees participate in an interactive water trading exercise at World Water Week 2016.



**MANAGING AGRICULTURAL
DROUGHT**

Bringing an agricultural drought monitoring and early warning system to India

DWFI is working with partners in the Indian Agricultural Research Institute to develop a drought monitoring and early warning system with integrated tools to enhance agricultural drought resistance throughout India.

India is one of the university's key partners for global engagement on many fronts, including agriculture, early childhood and public health — all areas affected by water and food security. Moreover, India is an important place to study and test ideas and methodologies, because it has both a very large population and many challenges in the supply, management and use of water to produce food.

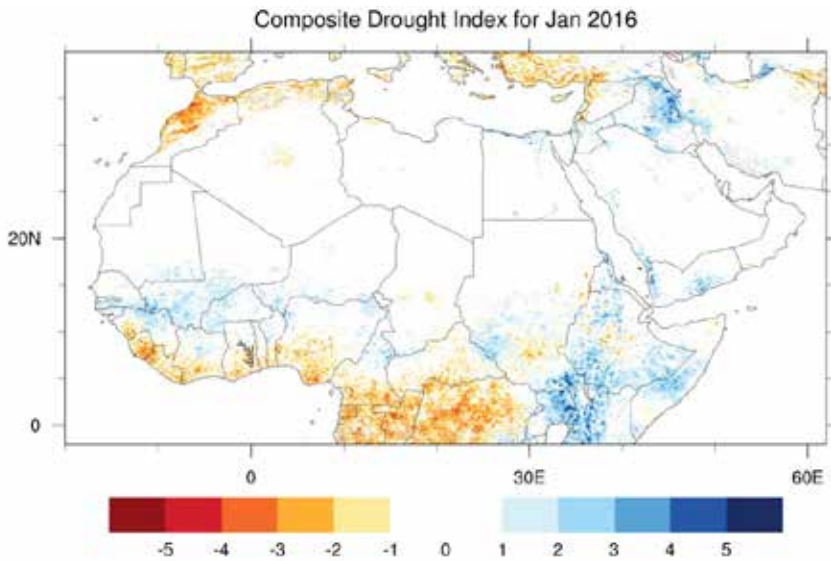
Together with our partners at the Indian Agricultural Research Institute (IARI), DWFI is developing an agricultural drought monitoring and early warning system for India, providing satellite-based evapotranspiration estimates and developing water-conserving sensor-operated irrigation systems. The goal is to use DWFI's knowledge and expertise to develop drought monitoring and management practices that will help India improve its water and food security.

In June, DWFI welcomed a delegation from IARI to a kickoff workshop for the project



entitled, “U.S.–India Partnership: Improving Water Management, Agricultural Production and Food Security in Drought-Prone Areas” funded through the INDO-US 21st Century Knowledge Initiative. During their four-day visit, IARI colleagues had a series of discussions with DWFI leadership and UNL and DWFI Faculty Fellow researchers surrounding ways to work together to improve drought water management, agricultural production and food security. The group observed some of the world-class research being conducted at UNL's Greenhouse Innovation Center and the UNL Eastern Nebraska Research and Extension Center near Mead, Nebraska. The delegation also visited DWFI's private industry partner LI-COR Biosciences while they were in Lincoln.

Colleagues from the Indian Agricultural Research Institute toured the University of Nebraska–Lincoln's Eastern Nebraska Research and Extension Center near Mead, Nebraska.



Bringing drought monitoring and early warning systems to the MENA region

DWFI is participating in the development of a drought monitoring system for the water-scarce Middle East and North Africa region to help farmers and governments prepare for and manage drought conditions and support agricultural productivity.

Together with the International Center for Biosaline Agriculture and NDMC, the institute is developing a drought monitoring system for the Middle East and North Africa region with funding from USAID. The goal is to develop a product that will help farmers and governments make effective water management decisions to increase agricultural productivity.

The three-year project is being implemented in two stages. The first stage is complete and focused on assessing the needs and gaps related to drought monitoring and management in the region, and developing a regional Composite Drought Index (CDI) monitoring tool. Stage two includes assessments for Morocco, Tunisia, Jordan and Lebanon and will transition to the final stage, where project partners and stakeholders from the four participating countries will use the risk assessment data to develop drought risk management plans.

DWFI's role in this project is to implement a satellite-based ET product, which will be used in the development of the regional CDI and drought early warning system and will also be used in phase two of the project to assess water resources in different agricultural regions, and eventually downscaled for irrigation water management and crop yield/water productivity estimations.


In December, the NDMC began the process of converting the CDI platform into open source code. In February, a team of scientists from the NDMC and ICBA helped train and transfer technology to the Tunisian participants, teaching them how to plot drought maps by weighting conditions and impacts. By mid-March, the participants had released their first gridded TCDI, the Tunisian version of the U.S. Drought Monitor. NDMC and ICBA further developed the CDI software during training sessions based on participant feedback.

NDMC fine-tuned the mapping processes and led hands-on training on the GIS software. NDMC also assisted the Tunisians in understanding the preliminary interpolation

methods — a numerical analysis of data — as well as in methods to check their accuracy. The Tunisians use these methods to evaluate precipitation data for their CDI.

Consultants are being hired to work collaboratively with the NDMC and ICBA to assist the project teams develop vulnerability assessments in each country. All assessments are expected to be completed in 2018.

Ultimately, the goal is to have a fully implemented and robust drought risk management system in place for each of the four countries. The development of an operational drought early-warning system via the CDI is an essential first step in doing just that. This effort is part of FAO's Near East and North Africa Water Scarcity Initiative, a 10-year project.



Ultimately, the goal is to have a fully implemented and robust drought risk management system in place for each of the four countries.

Nebraska leads research into heat-tolerant crops

Faculty Fellow Harkamal Walia, associate professor of agronomy and horticulture at the University of Nebraska–Lincoln, was awarded a \$5.78 million National Science Foundation grant to explore the effects of high nighttime temperatures on wheat and rice. Walia and his collaborators aim to gain a better physiological and genetic understanding of their heat stress responses, which may help drive the development of crops that are more resilient to higher temperatures in terms of yield and quality.

The stress of high nighttime temperatures can lead to severe declines in yield and crop quality. These losses are particularly high for wheat and rice, two major cereal crops worldwide. During the four-year project, Walia's team will investigate genes and genetic variants in wheat and rice to identify genetic markers and physiological characteristics tied to heat tolerance.

"The effect of high daytime temperatures on crop resilience has been studied, but this project will give us the opportunity to study the impact of high nighttime temperatures," said Walia, who received the award from the NSF's Experimental Program to Stimulate Competitive Research, or

EPSCoR. "Models suggest a greater widespread increase in nighttime temperatures than in daytime temperatures, so we need to develop rice and wheat resilient to these conditions."

Walia will lead a multidisciplinary team of Nebraska researchers, who will also collaborate with researchers from Arkansas State University and Kansas State University. The team uses a sophisticated image-based phenotyping system that takes high-resolution images of the plants as they endure simulated nighttime conditions. Software processes the images, detecting daily differences among the varieties that are not visible to the human eye. Matching slight variations with differences in each plant's genetic makeup will allow the team to identify the genes responsible for heat tolerance.

"Genetic improvement of crops for tolerance to increased heat, drought and salinity stress are an important component of an integrated approach toward global food security," said Walia, who will work closely with industry partners to translate discoveries into useful genetic and phenotypic markers.



EDUCATION AND ENGAGEMENT

2017 Water for Food Global Conference

The 2017 Water for Food Global Conference was a vehicle for conversation and collaboration, bringing together participants from around the world to share science, technology and policy expertise to help find solutions to water and food security challenges.

DWFI hosted its signature event, the **2017 Water for Food Global Conference**, April 10-12, at Nebraska Innovation Campus in Lincoln. While the event has evolved each year with different players and themes since 2010, the overarching goal is to advance water and food security challenges by bringing together researchers, farmers, students, practitioners, policy experts and others to share their knowledge and find opportunities for partnerships. The institute takes pride in its role as a convener; and this flagship event demonstrates DWFI's ability to provide a forum and framework for discussion, moving the needle toward greater water and food security.

This year's event, organized by the institute's small core staff, drew more than 425 participants and featured more than 100 speakers and panelists, representing more than a dozen countries. Over the course of three days, speakers shared case studies and perspectives on a variety of topics threaded under the theme: "Water for Food Security: From Local Lessons to Global Impacts." The theme stems from a belief that lies at the heart of DWFI's work: global breakthroughs come from local action. In addition, there are common challenges to improving water and food security in different contexts and scales.



Guided by DWFI's major focus areas (pg. 8), the plenary sessions, concurrent sessions, technical presentations and workshops applied that perspective to discussions addressing policy development, socio-economic dynamics, public-private partnerships, financing, technological innovations, sustainability and environmental stewardship. The conference topics also aligned with the World Water Forum agenda, so the conference served as a North American Regional Process event for the 2018 World Water Forum in Brasilia, Brazil.

DWFI directors worked on sessions with key partners, including USDA, EDF, USAID, FAO, IWMI, International Food Policy Research Institute and others. Formal conference partners included USDA and NDMC. Media partners included AgWired and The Water Network. Sponsorship was provided by the Daugherty

2017 Water for Food Global Conference panelists discuss expanding farmer-led irrigation in sub-Saharan Africa.

2017 WATER FOR FOOD GLOBAL CONFERENCE

425 CONFERENCE PARTICIPANTS FROM THROUGHOUT THE U.S. AND NEARLY 20 COUNTRIES AROUND THE GLOBE

SUPPORTING PARTNERS



NATIONAL DROUGHT
MITIGATION CENTER
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GOLD SPONSOR

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LI-COR Biosciences

Foundation, Monsanto, Senninger Irrigation, the Nebraska Corn Board and LI-COR Biosciences.

New this year, DWFI invited Faculty Fellows to submit topics for technical sessions that fit the conference theme, resulting in a full day of workshops and seminars showcasing the University of Nebraska's leading research in plant phenotyping, cropping systems, political science, geospatial technologies, science literacy and more. A highlight of the event was former California Secretary of Agriculture A.G. Kawamura's closing keynote and Heuermann Lecture.

Special events facilitated networking among participants, including two receptions; a student poster competition; a photography competition; a multi-media art exhibit; and a memorable bar-be-que banquet in Roca, celebrating Nebraska's 150th year of statehood.

As a direct outcome of the conference, leaders of the World Bank, USDA and USAID invited DWFI to co-convene a follow-up event at the World Bank in Washington, D.C., Jan. 29-30, 2018. The "Water for Food Symposium: Scalable Solutions" is a smaller-scale conference intended to develop new partnerships, as well as strengthen existing ones, and develop viable strategies for investment and support to expand sustainable irrigation and improve agricultural management in developing countries.

Student Support Program and Research Forum

DWFI is cultivating future researchers and water for food leaders through research support and Faculty Fellow mentoring opportunities.

The institute initiated its Postdoctoral and Student Support Programs in 2014. Since that time two postdoctoral scholars, 34 graduate students, and 17 undergraduate students have received support via the program. At least 10 have graduated and are currently working in their field or have gone on to graduate programs.

In May 2017, students and faculty working in multidisciplinary areas related to DWFI's objectives presented papers and presentations at the institute's Student Research Forum held in Lincoln, Nebraska. Students from more than 10 different departments from all four University of Nebraska campuses participated, showcasing their highly diverse expertise, ranging from engineering and physical sciences to agricultural leadership and political science.

This was the third in an annual series designed to highlight the students' research achievements, as well as demonstrate the institute's dedication to education and the students who will become the world's next water and food security experts and international collaborators.



Teacher professional development program earns grant support

Focusing on the complex interrelationships between water, energy and food is essential to discovering solutions to global water and food security. Teachers in secondary level education need training and tools to engage students in this vitally important area of study. DWFI staff and faculty are working together to develop and produce curricula for teachers, so they are well prepared to share insights and knowledge with their high school students.

The [Water Education Leaders for Secondary Science](#) project at the University of Nebraska-Lincoln recently earned a second grant to foster

University of Nebraska-Lincoln undergraduate scholars Grant Reiner (at left), Ethan Freese and Andrew Wentz discuss their DWFI-supported work with the Platte Basin Time Lapse Project.



Nebraska educators participate in the inaugural WELS2 workshop in June 2017.

science literacy about water resources issues among science teachers in Nebraska.

The 15-month continuing education program, led by Faculty Fellow Cory Forbes, associate professor of science education with the School of Natural Resources at Nebraska, will focus on supporting teaching and learning about water that links food, water, climate, energy and environmental challenges related to questions of water quality and quantity.

The program will serve 30 Nebraska middle- and high-school teachers from across the state. Teachers will participate in water literacy workshops; water science research projects conducted by water scientists in Nebraska; and online coursework through the College of Agricultural Sciences and Natural Resources Masters' of Applied Science, Science for Educators degree program. The course is worth the equivalent of 12.5 hours of learning support, and participating teachers will receive the WELS2 certification.

At the weeklong kickoff workshop held in Lincoln in June, participants focused on state and national science standards related to water, including the Next Generation Science Standards. The workshop also featured the Groundwater Foundation's Hydrogeology Challenge, a computer tool that introduces students to basic groundwater modeling techniques.

The WELS2 certification goal is to help teachers develop stronger knowledge of water and water resources that can be translated into their curriculum to improve students' understanding of water science and related issues. The project

will also contribute to statewide efforts, led by the Nebraska Department of Education, to review and revise standards for science teaching and learning in Nebraska.

The project is a partnership comprised of the School of Natural Resources, the Institute of Agriculture and Natural Resources Science Literacy Initiative, the Nebraska Collaborative for Food, Energy & Water Education, and water scientists, all at the University of Nebraska–Lincoln; DWFII; the Groundwater Foundation; and the Nebraska school districts of Lincoln, Omaha, Grand Island, Hastings and Millard.

DWFI builds on educational partnership with IHE Delft

DWFI, the University of Nebraska–Lincoln and IHE Delft have renewed their Memorandum of Understanding agreement for another five years, continuing an educational partnership that helps develop new global leaders in water and food security.

In partnership with the University of Nebraska–Lincoln and IHE Delft (formerly the UNESCO-IHE Institute for Water Education) in The Netherlands, DWFI offers a master’s-level double degree program for those seeking to gain knowledge and expertise in water management for agriculture. The Advanced Water Management for Food Production program allows students from around the world to gain valuable insights from leading researchers and hands-on field experience. The goal is to help develop water smart agricultural leaders around the world.



Dean Eisenhauer, DWFI Faculty Fellow and UNL Biological Systems Engineering Professor Emeritus, coordinates the effort. In April, Executive Director Peter McCornick and Faculty Fellow Francisco Muñoz-Arriola joined Eisenhauer in Delft to renew a Memorandum of Understanding that builds on the previous five years of collaborations.

Mumba Mwape, University of Nebraska–Lincoln engineering student from Zambia presents her research at the 2017 Research Forum.

The new agreement includes:

- ▶ Joint field courses, field trips and student exchanges between IHE and DWFI
- ▶ Collaborative research proposals/projects on water for food topics such as the application of hydroinformatics for improved water management, application of advanced technologies for irrigation management, water use efficiency, crop yield models, groundwater modeling, aquifer characterization and others

- ▶ Continuing implementation of the double Master of Science degree program that emphasizes the development and management of water for food production as detailed in a separate agreement
- ▶ Fostering opportunities for faculty exchanges between NU and IHE

UNL Biological Systems Engineering research assistant, Mumba Mwape, an irrigation engineering student from Zambia, successfully completed her thesis on “Selection and Design of Irrigation Systems in Zambia” and graduated

in May. She received her diploma from IHE in water science and engineering the following month. While in Nebraska, she gained career building irrigation management experience, which she plans to apply in her home country. Upon completing the program, Mwape returned to her appointment in a new role as a research manager for the Zambia Ministry of Agriculture.

In July, the institute published a report outlining the partnership’s key “Accomplishments and Impacts - 2011-2016” under the previous MOU, available on the DWFI website.

New courses help prepare future leaders in water for food

Undergraduate courses introduce students to the importance of water and food security, developing their knowledge and role as advocates.

In the spring semester, UNL students had the opportunity to take two new courses that explored water and the many ways it touches human life. The courses aligned with the institute’s student engagement efforts, helping educate future generations to make informed decisions regarding water use in agriculture.

Water in Society is a new freshman discovery class, jointly taught by Faculty Fellows Cory Forbes, Trenton Franz, and Director of Policy Nick Brozović. This team received a three-year National Science Foundation grant for research related to using the course as a platform for improving science literacy.

The course seeks to prepare students, regardless of major, to make informed decisions related to water, energy and food. Forty-five students completed the Water in Society course. As a direct impact of the program, two students from the class were selected for new internships at DWFI.

The **Global Water and Food Seminar** is a new graduate level course that gives advanced students a better understanding of the scientific and practical aspects of water’s role in food security and global development – from smallholder farming in Africa to highly-efficient agricultural production in the High Plains. This course was taught in spring semester 2017 by DWFI Founding Executive Director Roberto Lenton and Director of Policy Nick Brozović. Fifteen students completed the Global Water and Food Seminar course.





COMMUNICATION

Social media and websites: Leveraging digital communication

Digital communication is a powerful tool to reach DWFI stakeholders in Nebraska and around the globe. We leverage digital communication to raise the profile of the institute at the University of Nebraska as a global leader in water and food security and engage our stakeholders at local, regional and international levels.

DWFI's social media presence remains strong, with content regularly shared on Facebook, Twitter, YouTube, LinkedIn, Flickr and Instagram. Last year, the institute added SlideShare to its suite of social media platforms to share research presentations online more efficiently. The institute also uses Google AdWords to enhance its visibility to online audiences and boost search engine rankings. Key social media campaigns included coverage of the 2017 World Water Day, the 2017 Water for Food Global Conference, World Water Week and the United Nations World Population Day.

DWFI uses a media monitoring service to provide insight and analytics on our reach in traditional news media and social media. We track our communication efforts to learn what types of content most successfully engage our stakeholders. Our most popular platforms, Facebook and Twitter, experienced significant audience growth. Our Facebook page gained 6,500 new followers and our Twitter page gained 3,000 new followers. But, more importantly, we're engaging new audiences daily and enabling two-way conversation with our followers.

YOUTUBE AUDIENCE CONTINUES TO GROW



Interviewee Mumba Mwape

Top 20 Geographic Locations:

United States	Sri Lanka
Brazil	South Korea
India	Ireland
Canada	Egypt
Germany	Indonesia
Netherlands	Italy
United Kingdom	Spain
Kenya	South Africa
Ethiopia	Colombia
Australia	Ghana

NEARLY
80
VIDEOS POSTED

225
SHARES

9,392
TOTAL VIEWS

youtube.com/waterforfood



Faculty Fellow Jesse Korus, groundwater hydrologist at the University of Nebraska–Lincoln, asks a question during the Faculty Fellow Dialogue.

Our social media investment enables us to reach stakeholders around the globe. Fifty-four percent of Twitter followers are from the U.S. and the remainder are from countries around the globe, predominantly Brazil, Argentina and India.

The DWFI website at waterforfood.nebraska.edu is the communications hub for the organization, including links to leadership and staff, publications, events and a variety of news and information, including archived editions of the institute’s bi-weekly newsletter, the “Water for Food Digest,” and blogs written by staff, students, Faculty Fellows and partners. The website will soon move to a new, more flexible content management system with a fresh design that coordinates with the University of Nebraska’s branding. The new website will launch in 2018.

The institute is developing two new ancillary website projects: Drops and Crops and Farmer-led Irrigation in Africa. Drops and Crops is a student-driven website showcasing intern projects, such as policy briefs, videos and infographics. Farmer-led Irrigation in Africa is a new information resource on the DWFI website that focuses on center pivot irrigation’s potential to transform water and food security in sub-Saharan Africa and the steps needed to pursue and implement a center pivot system.

News media and publications: Telling the Water for Food story

While social media is a large component of the institute’s communication strategy, traditional news media remains an important means to share DWFI research and accomplishments. Last year, the institute produced and disseminated more than 14 news releases on partnerships, research projects and events. The institute, its staff and fellows garnered 584 news media mentions last year, an increase of 105 mentions compared to the previous year.

DWFI distributed a major international news release during the 2017 Water for Food Global Conference, announcing the important work being done to increase sub-Saharan Africa’s agricultural productivity through center pivot irrigation. The institute hosted a media conference during the event, which attracted

several regional media outlets, including the Lincoln Journal Star, Nebraska Educational Telecommunications, and Nebraska Farm Journal. AgWired live-streamed the press conference via Facebook. A list of DWFI's major news mentions is available under the "In the News" section of the [website](#).

Special Events

DWFI's special events help foster relationships with current and potential stakeholders and partners and elevate the institute's reputation at home and around the world. Events catalyze ideas and often lead to new partnerships and projects that advance the institute's mission.

DWFI communication efforts included special events throughout the year designed to encourage face-to-face interaction, share knowledge and enhance the DWFI brand. The communications team produced and promoted several special events during the fiscal year. Highlights include:

- ▶ Farewell reception for Founding Executive Director Roberto Lenton in August 2016, thanking him for his founding leadership of the institute and engaging University of Nebraska leaders, Faculty Fellows, students, staff and key stakeholders
- ▶ NU Connections Breakfast, held October 2016, bringing together leadership from the University of Nebraska's four system-wide institutes to share their organizations' missions and work with faculty, students and



the community. Peer institutes include, the Buffett Early Childhood Institute, National Strategic Research Institute and the Rural Futures Institute

- ▶ Faculty Fellow Dialogue, held in January, offering an update on the institute's priorities and progress and allowing faculty the opportunity to share ideas and provide feedback
- ▶ "Dreams to Dust," a multimedia exhibition at the Sheldon Museum of Art at the University of Nebraska–Lincoln examined our connection to the land over time through photography and [cinematic film](#). The exhibit was specifically created for the 2017 Water for Food Global Conference by DWFI Program Associate Morgan Spiehs and student intern Madeline Cass

DWFI intern Madeline Cass (left) and Program Associate Morgan Spiehs presented their multimedia exhibit at the Sheldon Museum of Art.

Science communication session at 2016 World Water Week

DWFI made a bold impression at 2016 World Water Week in Stockholm, leading a session on how to effectively communicate scientific research with various audiences.

“Telling Your Story to Make an Impact” provided practical steps for sharing research advancements in water and food security. Oftentimes researchers and others make remarkable scientific breakthroughs, but information about their research projects and results fails to reach those who need it most.



DWFI Director of Communications and PR Molly Nance leads discussion at the 2016 World Water Week session on “Telling Your Story to Make an Impact.”

DWFI staff, along with colleagues from CGIAR’s Research Program on Water, Land and Ecosystem (WLE), KickStart International, and Canary and Coal, a marketing communications firm, presented examples and communication tools participants could use to maximize the impact of their communication efforts.

The session looked strategically at communications and how researchers, policy makers and organizational leaders can more effectively achieve results by using the appropriate media and message.

The session filled the room and included participants from a variety of professions, organizations and countries. The workshop included interactive activities, where participants shared their own communication challenges and received feedback on how to develop a more effective approach. Participants also received a flashdrive containing resources for communication tips and techniques.

Sharing knowledge and best practices

The institute engaged in many conversations, collaborations and conferences with a wide variety of stakeholders at the state, national and international levels. DWFI outreach includes conferences, workshops, international exchanges, study tours, research forums and roundtables.

High-level meetings, conferences and seminars:

- ▶ High-level delegation from Ghana, visit to DWFI, including Hon. Fifi Kwetey, Minister of Food and Agriculture, Ghana – July 1, 2016 (Lincoln, Nebraska, USA)
- ▶ High-level delegation from Argentina, visit to DWFI – July 11-14, 2016 (Lincoln, Nebraska, USA)
- ▶ Council of State Governments West, Legislative Council on River Governance – Aug. 23, 2016 (Boise, Idaho, USA)
- ▶ World Water Week – Aug. 28-Sept. 2, 2016 (Stockholm, Sweden)
- ▶ Husker Harvest Days 2016 – Sept. 10-12, 2016 (Wood River, Nebraska, USA)
- ▶ “Virtual Water in Agricultural Products: Quantification, Limitations and Trade Policy,” workshop sponsored by the OECD Co-operative Research Programme: Biological Resource Management for Sustainable Agricultural Systems with co-sponsorship from Institute of Agriculture and Natural Resources, Water for Food Global Institute, LI-COR, and Nebraska Water Center – Sept. 14-16, 2016 (Lincoln, Nebraska, USA)
- ▶ Seminario da Agronomia (SAG) keynote, Federal University of Vicosa – Sept. 20 (Viçosa, Minas Gerais, Brazil)
- ▶ SPIE Remote Sensing Conference – Sept. 26-29 (Edinburgh, United Kingdom)



- ▶ High-level meetings with Nebraska congressional staff and other key stakeholders, including the State Department and USAID – Oct. 11, 2016 (Lincoln, Nebraska, USA)
- ▶ Ninth International Conference on Irrigation and Drainage – Oct. 11-14, 2016 (Fort Collins, Colorado)
- ▶ Annual meeting, W3190 U.S. Department of Agriculture Multistate Research Committee, “Management and Policy Challenges in a Water-Scarce World” – Oct. 13, 2016 (Lincoln, Nebraska, USA)
- ▶ Stakeholder Engagement Forum, Middle East and North Africa Regional Drought Management System project – Oct. 23-24, 2016 (Amman, Jordan)

Executive Director Peter G. McCormick provides a keynote address at the 2nd World Irrigation Forum in Thailand.

- ▶ Hastings College 2016 Artist Lecture Series Student Symposium keynote, “Water for Food: Myths and Misconceptions of Water in the West” – Oct. 25, 2016 (Hastings, Nebraska, USA)
- ▶ International Commission on Irrigation and Drainage, 2nd World Irrigation Forum – Nov. 6-12, 2016 (Xiang Mai, Thailand)
- ▶ National Ground Water Association and Irrigation Association joint congress on “Water for Food Security: Solutions for the Context” – Dec. 5-9, 2016 (Las Vegas, Nevada, USA)
- ▶ Nebraska League of Conservation Voters, Nebraska Conservation Summit, panel on “Climate Change, Food Security and Agricultural Production” – Dec. 7, 2016 (Omaha, Nebraska, USA)
- ▶ Nebraska’s Association of Natural Resources Districts, 2017 Legislative Conference – Jan. 24-25, 2017 (Lincoln, Nebraska, USA)
- ▶ Meeting with the Water in Agriculture Global Solutions group, Water Global Practice of the World Bank – January 2017 (Washington, D.C., USA)
- ▶ Groundwater Solutions Initiative for Policy and Practice (GRIPP) partners meeting – Feb. 8-9, 2017 (Geneva, Switzerland)
- ▶ High-level meeting with Instituto Nacional de Recursos Hidraulicos (INDRHI) – Feb. 12, 2017 (Santo Domingo, Dominican Republic)
- ▶ USDA Agricultural Outlook Forum – Feb. 24, 2017 (Washington, D.C., USA)
- ▶ Kenya’s National Drought Management Authority board members visit to DWFI – February 2017 (Lincoln, Nebraska, USA)
- ▶ League of Arab States International Conference, “Arab World Water Week 2017: Managing the Water, Energy and Food Nexus” – March 19-23, 2017 (Dead Sea, Jordan)
- ▶ World Bank Water Week Learning Days – March 22, 2017 (Washington, D.C., USA)
- ▶ Chicago Council on Global Affairs, 2017 Global Food Security Symposium – March 29-30, 2017 (Washington, D.C., USA)
- ▶ Islamic Development Bank Group, Agriculture and Rural Development Week: Inclusive Economic Growth through Productive and Resilient Agriculture – March 19-23, 2017 (Jeddah, Saudi Arabia)
- ▶ Columbia Water Center, World Water Day Symposium, “Americas’ Water: When Global Challenges Hit Home” – March 23, 2017 (New York City, New York, USA)
- ▶ World Bank Water Week – March 22-23, 2017 (Washington, D.C., USA)
- ▶ University of Nebraska–Lincoln “EarthStock” sustainability event – April 2017 (Lincoln, Nebraska, USA)
- ▶ AquaCrop-OS inaugural workshop – April 10, 2017 (Lincoln, Nebraska, USA)

- ▶ 2017 Water for Food Global Conference – April 10-12, 2017 (Lincoln, Nebraska, USA)
- ▶ UN Food and Agriculture Organization, Global Framework on Water Scarcity in Agriculture, partner meeting – April 19-20, 2017 (Rome, Italy)
- ▶ Indo-U.S. Workshop on Addressing the Nexus of Food, Energy and Water – April 19-21 (Bangalore, India)
- ▶ MOU signing with partners at the IHE Delft Institute for Water Education – April 25-26, 2017 (Delft, The Netherlands)
- ▶ DWFI 3rd annual Research Forum – May 11, 2017 (Lincoln, Nebraska, USA)
- ▶ Brazilian Symposium on Remote Sensing – May 29, 2017 (Sao Paulo, Brazil)
- ▶ 2017 Aspen-Nicholas Water Forum: Deepening Groundwater Sustainability – May 30-June 2, 2017 (Aspen, Colorado, USA)
- ▶ 8th World Water Forum - North American processing event – June 5, 2017 (Washington, D.C., USA)
- ▶ Workshop on “Water Markets: Formal and Informal,” jointly hosted by DWFI, USDA, and The Nature Conservancy at the World Bank – June 5, 2017 (Washington, D.C., USA)
- ▶ Indian Agricultural Research Institute delegation visits DWFI – June 19-22, 2017 (Lincoln, Nebraska, USA)

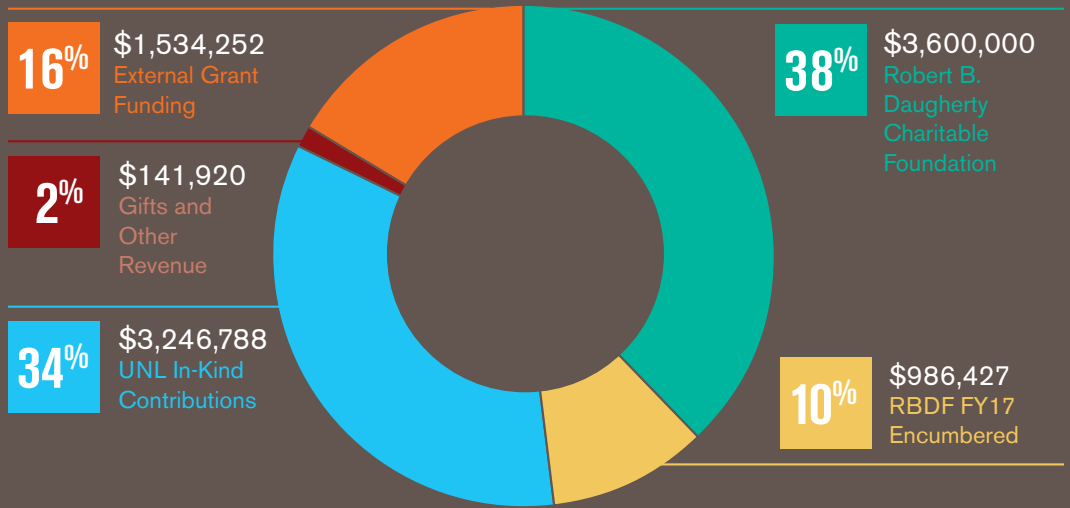


FINANCIALS

JULY 1, 2016 TO JUNE 30, 2017

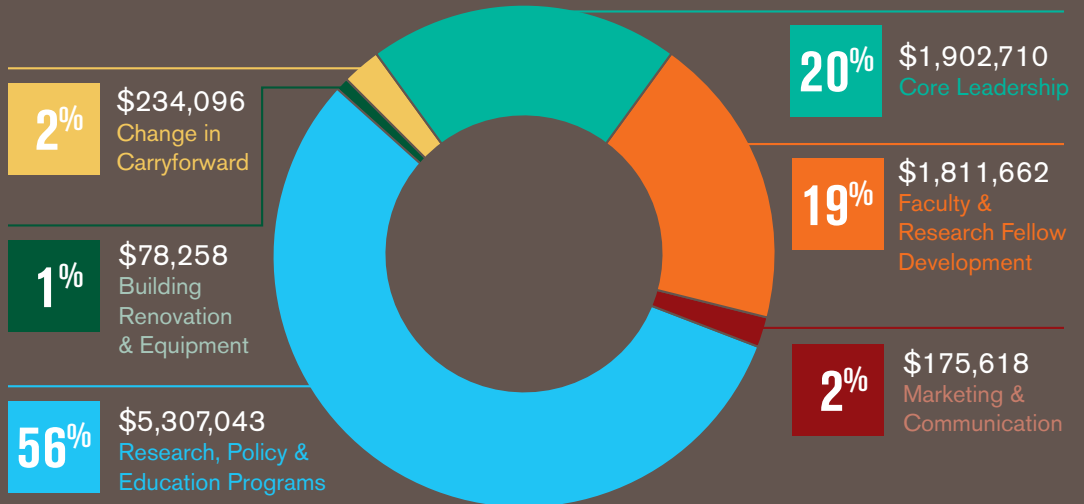
Funding Sources

\$9,509,388



Total Expenditures

\$9,509,388



STRATEGIC PARTNERSHIPS



Foundations

Robert B. Daugherty Foundation

Private Funding

Robert and Karla Baltzell

Dr. Bonnie L. Gerald and Mike Gerald

E. Robert and Angenette Meaney

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*In addition to the funding sources listed,
the institute received considerable in-kind
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For more information on how you can support
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or ck.duryea@nufoundation.org.*

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For a complete list of fellows and advisers, please visit waterforfood.nebraska.edu/about-wfi.



Daugherty Water for
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The 2017 Annual Report is published by the Robert B. Daugherty Water for Food Global Institute at the University of Nebraska. For more information, go to waterforfood.nebraska.edu.

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Acronym

	Organization/term		Organization/term
ALEXI-DisALEXI	Atmosphere-Land Exchange Inverse / Disaggregated Atmosphere-Land Exchange Inverse	NDMC	National Drought Mitigation Center at the University of Nebraska–Lincoln
ARS	Agricultural Research Service – U.S. Department of Agriculture	NET	Nebraska Environmental Trust
CDI	Composite Drought Index	NET	Nebraska Educational Telecommunications
DWFI	Daugherty Water for Food Global Institute at the University of Nebraska	NGO	Non-governmental Organization
EDF	Environmental Defense Fund	NIC	Nebraska Innovation Campus
ENREC	Eastern Nebraska Research and Extension Center	NOAA	National Oceanic and Atmospheric Administration
EPA	Environmental Protection Agency	NRD	Natural Resources Districts
ESALQ	College of Agriculture, University of Sao Paulo, Brazil	NU	University of Nebraska
ET	Evapotranspiration	NWC	Nebraska Water Center, part of the Daugherty Water for Food Global Institute
FAO	Food and Agriculture Organization of the United Nations	OECD	Organization for Economic Cooperation and Development
FAP	Faculty Advisory Panel	ORED	Office of Research and Economic Development at the University of Nebraska–Lincoln
GIS	Geographical Information System	RBDF	Robert B. Daugherty Foundation
GRIPP	Groundwater Solutions Initiative for Policy and Practice – International Water Management Institute	SIWI	Swedish International Water Institute
GYGA	Global Yield Gap and Water Productivity Atlas	SWM	Smart Water Metering Inc.
IANR	Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln	UAV	Unmanned aerial vehicle
IAP	International Advisory Panel	UN	United Nations
IARI	Indian Agricultural Research Institute	UNEP	United Nations Environment Programme
ICBA	International Center for Biosaline Agriculture	UNICEF	United Nations Children’s Fund
ICID	International Commission on Irrigation and Drainage	UNK	University of Nebraska at Kearney
IFPRI	International Food Policy Research Institute	UNL	University of Nebraska–Lincoln
IHE Delft	Institute for Water Education, Delft, The Netherlands	UNMC	University of Nebraska Medical Center
IUSSTF	Indo-U.S. Science and Technology Forum	UNO	University of Nebraska at Omaha
IWMI	International Water Management Institute	USAID	U.S. Agency for International Development
MDG	Millennium Development Goals	USDA	U.S. Department of Agriculture
MENA	Middle East and North Africa	VRI	Variable rate irrigation
MOU	Memorandum of Understanding	WARI	Water Advanced Research and Innovation
NARD	Nebraska Association of Resources Districts	WB	World Bank
NASA	National Aeronautics and Space Administration	WELS2	Water Education Leaders for Secondary Science
NDEQ	Nebraska Department of Environmental Quality	WLE	Water, Land and Ecosystem – CGIAR Research Program
		WWF	World Water Forum
		WWW	World Water Week (Stockholm)







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