Letter from the Director

I am proud to present this first annual report of the Robert B. Daugherty Water for Food Institute describing our initial activities and accomplishments during 2012 and 2013. Although our work is just beginning, we’re proud of all we’ve accomplished in this short period to begin to address one of the 21st Century’s most urgent challenges: ensuring global food security in the face of a changing climate and increasing competition for scarce water resources.

Located in one of the world’s major food-producing regions and in a state known for technological and institutional innovation, the University of Nebraska has a 144-year history of leadership in agriculture and the management of water. The work described in this report has been carried out by affiliated faculty of the University of Nebraska campuses – at Lincoln (UNL), Omaha (UNO), Kearney (UNK), and the Medical Center (UNMC). We also work with and through the Nebraska Water Center, which has a long record of engagement with the people of Nebraska and is now an integral part of DWFI. My colleagues and I are grateful to our affiliated faculty members and strategic partners for sharing our vision of a water and food secure world, and for working with us to build bridges across diverse disciplines and communities.

I would like to pay a special tribute to the leadership of the University of Nebraska, especially the President and his senior colleagues, for their vision for the institute and their extraordinary leadership in turning this vision into reality. I also wish to acknowledge with thanks the very generous financial support of the Robert B. Daugherty Charitable Foundation and other donor organizations that have contributed to our work, without which all the work described in this report would not have been possible.

Roberto Lenton
Founding Executive Director
Robert B. Daugherty Water for Food Institute at the University of Nebraska
Working to Ensure a Water and Food Secure World

The Robert B. Daugherty Water for Food Institute was founded in 2010 to address the global challenge of achieving food security with less pressure on water resources through improved management of water in agricultural and food systems. We are committed to ensuring a water and food secure world without compromising the use of water for other human and environmental needs.

Our approach is to extend the University of Nebraska’s expertise through strong partnerships with other universities and public and private sector organizations. Together we are developing research, education and engagement programs in a focused effort to increase food security while ensuring the sustainability of water resources and agricultural systems. We work locally and internationally, bridging the water and agriculture communities and the worlds of small- and large-holder farmers to deliver innovative solutions to this complex global challenge.
Over the past 50 years, dramatic increases in agricultural productivity driven by improved crop varieties, fertilizer use and the doubling of irrigated land kept pace with population growth. While the world population grew from 2.5 billion in 1950 to 7 billion today, the irrigated area doubled and water withdrawals tripled.

Now we face a population expected to increase to 9 billion by 2050, doubling the demand for food. The population not only is growing, it is growing wealthier. As wealth increases, people eat more dairy and meat, which require more water. The escalating need for agriculture to produce food, feed, fiber and fuel will exert intense pressure on the world’s water, land and energy resources.

The Water for Food Challenge

Over the past 50 years, dramatic increases in agricultural productivity driven by improved crop varieties, fertilizer use and the doubling of irrigated land kept pace with population growth. While the world population grew from 2.5 billion in 1950 to 7 billion today, the irrigated area doubled and water withdrawals tripled.

Now we face a population expected to increase to 9 billion by 2050, doubling the demand for food. The population not only is growing, it is growing wealthier. As wealth increases, people eat more dairy and meat, which require more water. The escalating need for agriculture to produce food, feed, fiber and fuel will exert intense pressure on the world’s water, land and energy resources.

The Water for Food Challenge

Over the past 50 years, dramatic increases in agricultural productivity driven by improved crop varieties, fertilizer use and the doubling of irrigated land kept pace with population growth. While the world population grew from 2.5 billion in 1950 to 7 billion today, the irrigated area doubled and water withdrawals tripled.

Now we face a population expected to increase to 9 billion by 2050, doubling the demand for food. The population not only is growing, it is growing wealthier. As wealth increases, people eat more dairy and meat, which require more water. The escalating need for agriculture to produce food, feed, fiber and fuel will exert intense pressure on the world’s water, land and energy resources.
Growing Demands on Water Resources
Water shortages already occur in many of the world’s major food production areas, and growing municipal and industrial demands are shifting more water away from agriculture. At a time when agriculture must produce more food, water supplies are stretched to meet increasing demands and a changing global climate holds unknown risks. Climate change could cause grain crop production losses of 50 percent or more, hitting hardest in countries already struggling with famine and drought.

Water for Food Production
Agriculture now consumes more than 70 percent of the world’s freshwater resources, the vast majority used for irrigating crops. Yet lack of water for irrigating crops is a constraint to producing food for millions of people in the world. In some areas, water is scarce due to too many demands or too little rainfall. In others, water may be available but access to pumps, power and appropriate irrigation technologies is scarce. We must find a way to produce more food using less water.

Irrigation

**Irrigated Ag**

- 20% of cultivated land
- 40% of food produced
- 60% of cereal production

Solutions

The Nebraska Agricultural Water Management Network of researchers and farmers uses soil moisture monitoring to reduce irrigation withdrawals.

In 2011 reduced by: 300 million cubic meters of household water for every Nebraskan

No-till farming can save 13 cm of the total 63 cm of water/hectare needed for an irrigated corn crop
Each year the global Water for Food Conference brings together thought leaders and experts from around the world to discuss potential solutions to the challenge of doubling our agricultural production by 2050 and doing it with less water than we use today.

We believe our conference is unique in its scope and commitment to bringing together the diverse groups and disciplines working on issues of water and food security. Since 2009 more than 1300 people from 28 countries including farmers, scientists, policy-makers, students, educators, politicians, conservationists, industry leaders and philanthropists have gathered to discuss the innovations in science, technology, policy and practice that will enable us to sustainably feed an increasingly hungry and thirsty world.

In 2012 Nebraska experienced its driest year on record and recent years have seen major droughts, floods and extreme temperatures affecting some of the world’s most productive agricultural regions. Our 2013 conference, “Too Hot, Too Wet, Too Dry: Building Resilient Agroecosystems,” focused on how we can increase the capacity of our food, water and natural ecosystems to adapt to a changing climate.

The mix of people and topics was exciting. Leading experts discussed climate change and its impact on food production, strategies for dealing with drought, and new approaches to agricultural sustainability through the science of resilience. Farmers and ranchers spoke about their efforts to sustain productivity while being good stewards of the land. Computer scientists demonstrated how drones can collect water data in remote sites. Participatory researchers described their work with smallholder farmers in India, Sub-Saharan Africa and Central America.

We look forward to continuing the discussions at the 2014 Water for Food Conference on October 19-22 in Seattle.
Policy Dialogues

DWFI is extending its reach by hosting and participating in policy dialogues in the water and food sector. The past year included:

- Two World Water Day events in Washington D.C. co-sponsored with the Global Harvest Initiative focused on building resilient agroecosystems in a changing climate.
- An expert consultation on Yield Gap Analysis, co-hosted by DWFI, the Food & Agriculture Organization and the Stockholm Environment Institute at FAO headquarters in Rome in October.
- Institute on Science for Global Policy conference on “Food Safety, Security, and Defense: Focus on Food and Water” at the University of Nebraska-Lincoln, October 20-23.

“We believe very strongly that you have to include the voices of these farmers, their families, in the work that we do.”

Jeff Raikes, CEO of the Bill & Melinda Gates Foundation, speaking about participatory research

From left: Paul Hicks, Aditi Mukherji, Karen Villholth, Ravinder Kaur, Jeff Raikes
Innovative Solutions to Complex Challenges

Research is at the core of DWFI programs. Our goal is to create knowledge, innovations, and effective solutions to sustainably manage water and increase food security, inform policy, and give students hands-on experience in the lab and the field. We extend our work through collaborative research programs in Nebraska and major agricultural areas of the U.S., India, Brazil, and China, and other selected countries in Sub-Saharan Africa, the Middle East, North Africa and Latin America.

Our research programs currently focus on sustainably increasing crop yields and water productivity using mapping, modeling and information systems; increasing the sustainability and productivity of crops and livestock under water-limited conditions; and improving drought management and climate change adaptation through monitoring programs, preparedness strategies and stronger warning systems.

DWFI research grants support promising new ideas from teams of NU faculty and colleagues at other academic institutions and fund projects with our partners. Three projects are highlighted here.

A Holistic Approach to Sustainable Food Security: Adaptive Watershed Management in Ethiopia
Agriculture is the backbone of the Ethiopian economy, but drought, declining crop yields, high population growth and poverty have resulted in chronic food insecurity and water shortages. A UNL team led by Martha Mamo and Tsegaye Tadesse, working with faculty from Haramaya and Wollo Universities in Ethiopia, is taking a holistic approach to watershed management to tackle these problems. Working with Ethiopian farmers, they are mapping groundwater; collecting data on irrigation, cropping systems and soil and crop resources; surveying household water use; and developing and evaluating irrigation technologies.

More Roots, More Water, More Yield: Root Genomics and Physiology to Enhance Water Use Efficiency
Wheat is a major food crop, especially in dry areas of the globe. A key strategy for sustaining crop yields when water is limited is to increase water use efficiency (WUE). Roots are fundamentally important for high WUE but are largely unexplored. UNL agronomists P. Stephen Baenziger and Harkamal Walia are working to improve wheat’s WUE by identifying novel genes from wild wheat that increase root biomass and the plant’s ability to access water and increase yield. The long-term goal is new wheat varieties that will yield more using less water.
The Potential of Collaborative Governance: The Platte River Recovery Implementation Program

The Platte River Recovery Implementation Program is a Cooperative Agreement signed by three states, two federal agencies, representatives of water users and environmental interests in its fifth year of implementation. A team led by UNO faculty Christine Reed and John McCarty found that collaboration during this initial period resulted in innovative approaches to retiming river water, which generates water for irrigation and increases river flow to benefit endangered and threatened species. New governance reform such as this has the potential to influence investments in new technologies that can conserve water for multiple uses.
From left: Justin Van Wart, Patricio Grassini, Ken Cassman
The Global Yield Gap and Water Productivity Atlas: A Global Project with Local Relevance

As the world’s population explodes to an estimated 9 billion people by 2050, farmers face the daunting challenge of making the most of every hectare of suitable land while preserving rainforest, wetlands and other land unsuitable for farming. “The critical question is: Where in the world do we have existing farmland with the capacity to produce much higher, stable yields?” said Ken Cassman, Robert B. Daugherty Professor of Agronomy at the University of Nebraska-Lincoln.

To answer that question, Cassman and an international research team are developing a web-based, advanced modeling and mapping tool to identify existing farmland around the globe where significant gaps exist between actual and potential yields for different crops. Yield potentials vary widely and often are difficult to measure.

Unlike other efforts to estimate yield potential, the team’s Global Yield Gap and Water Productivity Atlas uses a bottom-up approach. The project includes agronomists from each target country to identify key agricultural areas and collect data about local conditions and farming methods. These data are scaled to the national, regional and global levels. The UNL team and partners from Wageningen University in The Netherlands also are developing the necessary methodology, such as accurately converting short-term weather data into long-term patterns and scaling up local yield estimates. All information and methodologies will be shared on the public website www.yieldgap.org.

“The beauty of this project is that it is a global project but with local relevance,” said UNL agronomist and co-investigator Patricio Grassini. The atlas will estimate global yield trends and food security but also help individual countries identify production potential to better strategize resource allocations and trade opportunities.

DWFI funded initial Atlas development and the maps for Brazil and Argentina. A grant from the Bill & Melinda Gates Foundation is funding the work in India, Bangladesh and 10 Sub-Saharan Africa countries. A partnership with USAID’s Middle East and North Africa Network of Water Centers of Excellence provides resources for mapping Jordan, Morocco and Tunisia.
Sharing the Common Goal of a Water and Food Secure World

We believe in partnerships based on a common goal, where we combine our interests, expertise and resources to move us closer to achieving a water and food secure world. DWFI is exploring and developing collaborative programs with partners from academia, the private sector, governmental agencies and NGOs that will catalyze innovations in research and education related to water for food.

The Food and Agriculture Organization of the United Nations and DWFI are partnering in three areas: to sustainably increase crop yields and water productivity using mapping, modeling and information systems; to improve drought management through monitoring programs, risk-based preparedness strategies and policies, and stronger warning systems; and to improve sustainable production under stress and water-limited conditions through basic and applied plant science.

USAID and DWFI are partnering to reduce the use of water in agriculture while sustainably maintaining crop yields, working through the Middle East and North Africa Network of Water Centers of Excellence. The collaboration is focusing on irrigation, groundwater management, drought risk assessment and mitigation, and crop systems modeling. An initial project is development of the Global Yield Gap Atlas for Jordan, Morocco and Tunisia.

The Indian Agricultural Research Institute is collaborating with DWFI on a broad research program addressing drought and its impacts. A drought monitoring and early warning system with integrated tools for quantifying drought impacts on irrigation water will be a major focus. Other projects include developing abiotic stress tolerant wheat, maize and soybean genotypes; phenotyping protocols for salinity and drought stress screening in rice; and irrigation scheduling software to improve efficiency.

Valmont Industries Inc., World Vision and DWFI are collaborating to develop highly efficient and affordable irrigation systems and supporting agricultural business systems to help build sustainably improved and resilient livelihoods for smallholder farmers.
Jain Irrigations Systems, Ltd. and DWFI have a research and education partnership focusing on three initial projects: improving drought and salt tolerance of maize and bananas using genomics and phenomics techniques; training in plant transformation and other biotechnology techniques; and crop water productivity and best irrigation management practices for bananas and maize.

The DWFI is pleased to be a consultative partner to the Global Harvest Initiative and a member of the U.S. Water Partnership and the Global Water Partnership.
Real Problems, Real Solutions

As part of a leading land-grant university with nearly 150 years of experience in education and research related to water and food, educating the next generation and engaging dedicated people in this work are central to our mission. We are developing programs with partners whose expertise complements our own and who bring perspectives from diverse disciplines, experiences and cultures.

DWFI believes that students are best engaged through tackling real problems that require real solutions and provide a sense that their work can make a difference in the world. Our programs provide opportunities for hands-on research, experiential learning and support for undergraduate and graduate research and education. Initial programs include a joint double MSc degree program with UNESCO-IHE; a double-degree program in agricultural engineering with the University of Sao Paulo-ESALQ; development of a Water for Food minor; Undergraduate Research Scholar awards; and targeted investments such as the Phocalstream project.

Phocalstream is a software tool developed by students in the Design Studio in UNL’s Jeffrey S. Raikes School of Computer Science and Management. It will enable students grade 6 and older to create videos from the thousands of photos taken by the Platte Basin Time-lapse project, led by Michael Forsberg and Michael Farrell of UNL. Users can couple the images to data from other sources, and share their videos, photos, photo annotations, and collections using social media.
Experiencing Agriculture in a New Way

Measuring flow in a pristine Nebraska Sandhills stream and soil moisture in a young field of soybeans, 17 students from around the world experienced agriculture in a new way. The students were the vanguard of an international education partnership between DWFI and UNESCO-IHE Institute for Water Education in the Netherlands, the world’s largest international postgraduate water education facility. The partnership agreement includes a new joint master’s degree program in Advanced Water Management for Food Production, beginning in the 2013-14 academic year, and student and faculty exchanges and research collaborations.

The students visited Nebraska in May 2012 for the inaugural field methods course, developed by UNL faculty and their UNESCO-IHE counterparts. The course provides hands-on field experience in agricultural production and water resources management in Nebraska, drawing on UNL expertise in food production, irrigation and water management.

The field experience exemplifies the power of DWFI’s partnership with UNESCO-IHE, which brings students from developing countries to its campus in Delft, The Netherlands to learn about the science of water management. UNESCO-IHE’s strong programs in hydrology, water science and engineering and water management systems are complemented by UNL’s expertise in agricultural and irrigation engineering. Students graduate with two MSc degrees, in Water Science and Engineering and Agricultural and Biological Systems Engineering.
New Leadership

Christopher Neale
Director of Research, leads development of research projects with faculty and partners and ensures that our programs are expanding the mission and advancing the work of the Institute.

Monica Norby (until 30 September 2013)
Associate Director, management of communications, external relations, and engagement of faculty with programs and research projects, and coordination of operations and finances.

Chittaranjan Ray
Director of the Nebraska Water Center, leads engagement of the Institute with researchers and stakeholders focused on water issues in Nebraska and surrounding regions.

E. Robert Meaney
Daugherty Distinguished Fellow, brings his international business experience to building strong partnerships and research collaborations, with an emphasis on developing practical solutions to the water and food challenge.

Board of Directors
James B. Milliken, Chairman
President, University of Nebraska

Mogens Bay
Chairman, Robert B. Daugherty Charitable Foundation

Jeff Raikes
CEO, Bill & Melinda Gates Foundation

DWFI Staff
Rachael Herpel
Research and Outreach Coordinator

Marc Andreini (until 30 June 2013)
International Research Fellow

Craig Eiting
Web Developer and Graphic Design Specialist

Dana Ludvik
Communications and Marketing Specialist

Janet Means
Administrative Associate

Jesse Starita
Education/Outreach Specialist

Nebraska Water Center Staff
Steven W. Ress
Communications Coordinator

Tricia Liedle
Program Assistant

Daniel Snow
Director, Water Sciences Laboratory
Credits

The Water for Food 2012-2013 Report is published by the Robert B. Daugherty Water for food Institute at the University of Nebraska. More information is available at http://waterforfood.nebraska.edu or contact:

Dana Ludvik
Communications and Marketing Specialist
234 Whittier Research Center
2200 Vine Street
Lincoln, NE 68583-0860 U.S.A.
402-472-9510 • dludvik@nebraska.edu

Editor and Writer
Monica Norby

Contributing writer
Gillian Klucas

Photography: Craig Chandler, Brett Hampton, Platte Basin Timelapse/Michael Forsberg, Jackson Studios, Robert Cope

Design: Modus Persona

Sources for infographic:
http://econ.world bank.org
http://fao.org
http://water.unl.edu/NAWMN
http://cropwatch.unl.edu/web/cropwatch

Connect with us:
https://twitter.com/waterforfood
https://www.facebook.com/waterforfoodinstitute

The University of Nebraska is an Affirmative Action/Equal Opportunity institution.