



Strategic Plan November 2015

Preface

In May 2013, the Board of Directors for the Robert B. Daugherty Water for Food Institute at the University of Nebraska (WFI) approved the institute's initial strategic plan. At the time of Board approval, the Institute was in the early stages of its development and none of the program directors had yet been appointed, so the initial strategic plan was deliberately flexible; its main purpose was to provide a framework for the institute's initial activities within which it could explore different approaches and learn lessons that would assist it in developing a clear and strong strategy for the second stage of its work commencing in 2015. It was therefore agreed that in early 2015 the strategy would be reviewed and updated to cover its second full phase of operations from 2015 to 2020. This strategic plan represents the outcome of this work. The document was approved by the Board in April 2015, subject to some revisions and clarifications to incorporate feedback received, which have been incorporated in this final version of the strategy.

The Challenge

The Institute was established to address one of the most urgent challenges of the 21st century, with significant political, environmental, social and economic implications: how to achieve greater food security with less pressure on water resources. To ensure sustainable global food security in the face of a changing climate and the growing demand for scarce water resources to meet other human and environmental needs, we will need to improve water use and management by and for agricultural and food systems.

Achieving global food security – by which we mean ensuring that everyone, everywhere, has access to enough safe and nutritious food for a healthy, active life – is commonly viewed as resting on three pillars: physical availability of food, access to food (ability to either produce or purchase food), and food use at the household level. The effective management and use of water is vital for each of these three pillars. Water is a critical input for both crop and livestock production and a significant amount of the world's freshwater resources are consumed for these purposes. Water also plays a vital role in generating livelihoods and the overall economic growth that is required to ensure economic access to food supplies by the world's most vulnerable people. Access to safe drinking water and basic sanitation by poor households is critical to ensuring that food use at the household level is safe and that caloric loss from water fetching and diarrheal diseases does not negatively impact nutritional levels.

The effective management of water by and for agricultural and food systems to ensure food availability in the years to come is a critical issue. Food requirements are expected to double by 2050, not only because of population growth, but also because of rapidly rising incomes and changing diets in many parts of the developing world. What's more, rapidly increasing water requirements to meet human, industrial and environmental needs, coupled with rapid urbanization and increasing degradation of water resources in both quantity and quality terms, means that the water supplies available for agricultural

purposes in the years to come are likely to be much more limited than at present – a situation that will be even more complex as a result of climatic extremes and change.

All this will require significant improvements in water productivity, a measure of the amount of water needed to produce an amount of output such as food or fodder. Importantly, improvements in water productivity will need to take place along the entire food value chain, including not just irrigating farmers, but also processors and other agribusinesses. Achieving more food security with less stress on scarce water resources requires a holistic perspective that goes significantly beyond increasing “crop per drop.” It involves improving the use of water not only in crop production systems, but also in livestock production, which will be particularly important in view of rising incomes and consequent increases in consumption of livestock products in low- and middle-income countries, as well as in integrated cropping/fisheries/livestock systems and food production processes. Efforts to increase food production need to be complemented by efforts to reduce food waste, which is also water waste.

While producers in some countries have already made considerable gains in raising the productivity of water for crop and livestock production, there is still opportunity for improvements around the world. Better land and water management are crucial in bridging the existing yield gap between high-yield and low-yield farms, whether expressed per unit of land or per unit of water consumed. Plant breeding for abiotic stress conditions, biotechnology and molecular biology, precision irrigation, deficit irrigation and soil conservation, groundwater management and recharge, improved farming practices, and proper incentives and institutional arrangements all play a role in enhancing crop and livestock water productivity.

Ensuring the sustainability of agro-ecosystems in water-limited conditions is a particularly important challenge at basin, agro-ecological and higher scales. In many watersheds, the key challenge is to find ways to reconcile the use of water for agricultural purposes with the need to allocate water to maintain environmental services. Here the increasing use of wastewater and reuse of water for agriculture will be important, given the central role of water quality and water reuse to many agricultural water users. At the watershed and agro-ecological levels sufficient water should be reserved for maintaining environmental flows, biodiversity, and local livelihoods. Economic, biological, ecological, social, political and institutional studies of agro-ecosystems in water limited conditions are required to analyze trade-offs and develop adaptive capabilities and ensure sustainability of agro-ecosystems.

These enormous challenges play themselves out in a variety of different food production contexts, from the large-holder and highly productive systems characteristic of major food exporting countries to the more vulnerable small-holder producer systems in Sub-Saharan Africa and the Indian sub-continent. Since water availability and requirements as well as technology and policy options for water management are driven by local conditions, both problems and solutions are context-specific. Despite these major differences, however, some of the major problems that need to be solved in the quest for greater water and food security cut across a range of contexts. Subject areas of priority importance in a range of different contexts and central to water and food security both in the United States and globally include:

Closing water and agricultural productivity gaps: Producers across the world, from large-holder irrigated farms in major food exporting countries to small-holder rainfed farms in the world's poorest countries, need to manage water in ways that close yield and water productivity gaps. Efforts to close productivity gaps in crop and livestock systems requires work to identify gaps, diagnose the reasons for their existence, and develop context-specific solutions. Since many agronomic, water, climate, social, economic and institutional factors lie behind the existence of water and agricultural productivity gaps, successful efforts will require interdisciplinary approaches that combine understandings from the physical, biological and social sciences.

Groundwater management for agricultural production: Improving the sustainability of groundwater systems is a major challenge in rich and poor countries alike. In recent decades there has been a significant increase in the use of groundwater for agricultural production, including in India, China and the USA, leading in many cases to use rates in excess of groundwater recharge and thus rapidly decreasing groundwater levels that threaten sustainability of agricultural production. There is a clear need for

practical and implementable approaches to improving groundwater management, based on scientific understandings of the dynamics of linked human and natural components of groundwater and on lessons learned from successful experiences in controlling groundwater use.

Enhancing High Productivity Irrigated Agriculture: In many parts of the world, improving the lives and livelihoods of farmers as well as the prosperity of the region in which they live will require the expansion of irrigated areas and/or the adoption of high-productivity technologies and practices. High productivity irrigation provides an opportunity for farmers to increase yields as well as grow two or three crops per year on a continuous basis rather than only one, enabling farmers to have year-round income streams and get products to local markets when prices are high. Advancing high-productivity irrigation depends on multiple physical, environmental and socio-economic variables and will require improved understanding of technical, management and policy issues, including drought management and prediction.

Freshwater and Agricultural Ecosystems and Public Health: Across the world, improving water and food security often has significant impacts on the health of people and the environment. The expansion of irrigation, for example, has been linked to the spread of malaria and schistosomiasis in some parts of the world, especially in Africa. Likewise, in river basins as far apart as the Murray-Darling in Australia and the Platte in Nebraska, the use of water for agriculture competes with the use of water to provide environmental services that are vital to long-term ecosystem integrity. Ways need to be found to allocate water effectively among competing uses and in particular to ensure that programs to improve water and food security also advance ecosystems and public health, based on a strong scientific understanding of the links between water, agriculture, environment and health and drawing on expertise in natural resources management, economics, environmental science, water quality analysis, and public health.

Management of Agricultural Drought: Droughts affect farmers in most regions of the world, with severe global as well as local impacts, and will likely become more frequent and severe in the future as a result of climate change. Droughts also provide opportunities to change the way that long-standing problems are addressed and to establish more effective water management policies and practices. New approaches are needed to manage drought that emphasize long-term solutions rather than short-term responses to specific events. Such approaches need to include both long-term water conservation (e.g. through improving water and agricultural productivity, irrigated agriculture, and groundwater management) as well as drought monitoring and mitigation (e.g. through the use of drought management decision-making tools).

Nebraska's experience in these areas is an important contribution to global efforts to improve agricultural water management. Nebraska producers are recognized as innovators in irrigation technology, use of soil water content sensors, drought-resistant crops, conservation agriculture and other technologies and methodologies. Nebraska policy makers are also recognized as innovators at an institutional level. The 1972 decision to establish Natural Resources Districts (watershed-based governance entities led by locally-elected Boards of Directors) provided an effective institutional framework for managing the groundwater resources that are so vital to the state's agriculture, and for potentially reconciling agricultural and environmental water needs. And Nebraska's positive experience with the massive 2012 drought, when its corn and soybean yields were not impacted nearly as severely as the magnitude of the drought would have suggested, highlights the importance of high-productivity irrigation, water conservation practices and other factors that protected farmers against drought.

Addressing these challenges will require scale- and context-specific science and research-based solutions. Indeed, it is hard to see how we could address such challenges without a marked increase in innovation and in our basic understanding of the natural and human dynamics underlying relevant water and food processes. But the current pace of innovation in the use and management of water in the production of food is still low in relation to other sectors and especially in relation to the scale of the challenge. To improve water and food security, we will need combinations of technological, social, institutional and policy innovation and much lateral thinking, purposefully seeking to inject new ideas and creativity by working across different contexts.

Core assets and expertise to address the challenge

This section details the institute's core assets and expertise in relation to water and food to lay the ground for the subsequent delineation of the Institute's subject areas of focus.

The Institute's principal asset to address the challenges described in the previous section is that it is an integral part of the University of Nebraska with its significant expertise in a range of disciplines related to water and food and a strong track record of research in the subject. The University of Nebraska system includes the University of Nebraska at Lincoln, Omaha and Kearney (UNL, UNO and UNK respectively); the University of Nebraska Medical Center (UNMC); the Nebraska College of Technical Agriculture in Curtis; and four system-wide institutes, including WFI and the Rural Futures Institute (which supports rural communities and regions to achieve their desired futures). The University has faculty experts in water sciences, agricultural sciences, information sciences, social sciences, law and public health and administration as well as specialized centers on issues of great relevance to water and food.

One important specialized center is the Nebraska Water Center, which was established by Congressional mandate as one of 54 Water Resources Research Institutes in 1964 and is now an integral part of the WFI. The NWC facilitates research addressing water problems or understanding of water; helps new water researchers; trains future water researchers and engineers; and publishes water research results to water professionals and the public through publications, research colloquia and conferences, lectures and tours. The Water Sciences Lab, which is part of the Nebraska Water Center, is the largest analytical lab with the most advanced instruments and capacity based at a U.S. water center. The NWC has a track record of providing state-of-the-art analytical technology for conducting research in water resources conservation for food production systems; serving as a technical resource to federal, state, and local officials on measurement methods and potential impacts to water quality and human health from the use of water resources for food production; and providing hands-on training of water scientists and engineers to help make informed decisions and shape policies impacting water resource quantity and quality.

Another important specialized center is the National Drought Mitigation Center (NDMC), which helps people and institutions develop and implement measures to reduce societal vulnerability to drought, stressing preparedness and risk management rather than crisis management. The NDMC participates in the preparation and maintenance of the U.S. Drought Monitor website; develops the U.S. Drought Impact Reporter, a suite of web-based drought management decision-making tools. The center also contributes to drought planning and mitigation; drought policy; advising policy makers; and collaborative research. The NDMC participates in numerous international projects, including the establishment of regional drought preparedness networks in collaboration with the United Nations' Secretariat for the International Strategy for Disaster Reduction.

UNL's Institute of Agriculture and Natural Resources (IANR) is a critically important locus of expertise that brings together all of the University's resources relating to food, water and other natural resources. IANR innovation in research, teaching, and extension education places Nebraska on the leading edge of food production, environmental stewardship, human nutrition, business development, and youth engagement. IANR houses several departments of great relevance to water and food, including Biological Systems Engineering, Agronomy and Horticulture, Agricultural Economics and Food Science and Technology, and its Vice-Chancellor also serves as Vice-President for Agriculture and Natural Resources for the University of Nebraska as a whole. IANR also houses the School of Natural Resources at UNL, which is recognized as an international leader in natural resources education, research, and outreach as well as the primary provider of natural resources information and service to Nebraska, and which itself includes several centers of expertise of relevance to WFI such as the NDMC and the Center for Advanced Land Management Information Technologies (CALMIT), which focuses on remote sensing, geographic information systems and global positioning systems. IANR also includes the Center for Plant Science Innovation, whose faculty carry out research on such subjects as plant-microbe interactions, plant signaling and organellar biology, abiotic and biotic stress responses, and genomics/proteomics. The plant research community at IANR allows for a host of productive collaborations such as plant breeding programs that incorporate modern technologies for crop improvement, an excellent ecology and evolution group that integrates an understanding of plant function to their natural environment, and an array of

faculty investigating the food safety, environmental impact, and economic implications of agricultural biotechnology. Finally, a significant number of IANR faculty and administrators are globally-recognized livestock specialists with important links to the livestock industry, and the institute includes the UNL Panhandle Research and Extension Center in Scottsbluff with expertise in livestock production.

A further important center of relevant expertise at the University of Nebraska is the College of Public Health at UNMC, which promotes health and well-being through education, research, and service in collaboration with communities in Nebraska, across the country, and around the world. The strong engagement of the College in the development of WFI since inception provides a special comparative advantage for WFI to engage in the area of water, food and health and to foster creative collaborations among specialists in these subjects in research, policy and education.

Importantly, while the University of Nebraska's significant expertise in water and food is undoubtedly its main asset, another set of WFI core assets is its external partnerships that enable it to access additional expertise and extend its global reach. The institute now has a significant infrastructure of partnerships with key national and international organizations. In particular, WFI has formal agreements with the UNESCO-IHE Institute of Water Education in Delft, the Netherlands; USAID and the USAID Water Centers of Excellence for the Middle East and North Africa; the Food and Agriculture Organization (FAO) of the United Nations in Rome; the International Water Management Institute (IWMI) in Sri Lanka; Jain Irrigation in Jalgaon, India; and the Indian Agricultural Research Institute in New Delhi India. In addition, WFI draws on formal agreements between the Institute of Agriculture and Natural Resources at UNL with the University of Sao Paulo in Brazil and the Institute of Water Resources and Hydropower Research in Beijing, China, to facilitate WFI collaborations.

Our Vision and Mission

The Robert B. Daugherty Water for Food Institute at the University of Nebraska, established in 2010 through a generous \$50 million grant from the Robert B. Daugherty Foundation, was created to combine the best of the University's expertise in water and food to address the challenges of improving the use and management of water in agriculture. Our vision is for a food and water secure world: one in which global food security is ensured without compromising the use of water to meet other pressing human and environmental needs. Our mission is to have a lasting and significant impact on achieving more food security with less pressure on scarce water resources, by conducting scientific and policy research, using the results of research to inform and advise policy makers, and educating the necessary human talent. In keeping with the global nature of our vision and mission, our institute works locally, near our home base in the center of one of the world's most important food producing areas; works nationally, and works internationally, particularly in other parts of the world facing critical water for food challenges.

To maximize the opportunities for innovation that our mission requires, our institute builds bridges across the worlds of large-holder and small-holder agriculture, which traditionally have moved in different circles. We also bridge between different communities of expertise and focus, in particular the water community and the agriculture/livestock communities. These are not easy bridges to build, as specialized disciplines within these communities often have little interaction with one another, belonging to different professional associations and attending different professional conferences. In taking on this task, we recognize that our work is challenging.

Our Stakeholders

In developing the institute's strategy, it is important to take into account the needs of both internal and external stakeholders. Internally, the institute engages the University of Nebraska community working on water and food issues, with which it shares a sense of mission and common goals and works to assist faculty to contribute effectively to this mission. Externally, the institute reaches stakeholders within Nebraska, across the country, and internationally.

The institute considers its principal stakeholder groups, in the US and overseas, to be as follows:

- Agricultural producers and other water managers
- Local, state, national and international decision makers
- Practitioners and decision makers in industry groups, private companies, non-profits and NGOs
- Faculty, scholars, and undergraduate/graduate students at NU and other educational institutions
- The general public

Our Comparative Advantages

There are a number of international institutions engaged in work that is relevant to the mission of WFI, most importantly the International Water Management Institute. There are also a growing number of interdisciplinary water-themed institutes and programs at U.S. universities, such as at Michigan State University, Oregon State University, UC Davis, Johns Hopkins, Columbia and Duke (though most have not defined their focus specifically in “water for food” terms).

Given the magnitude of the challenge and the existence of other players in the field, it is essential for WFI to define what it is uniquely qualified to contribute, what distinguishes it from other players, and what makes it an innovative new contributor to the field. In doing so, we have taken into account the principal assets that the institute can bring to the table, over and above the expertise of the University of Nebraska as previously outlined: its specific focus on “Water for Food”; its location in one of the world’s most important food producing areas and in particular in the state of Nebraska; the Daugherty Foundation gift, which provides WFI with a solid initial financial base and the ability to move quickly and flexibly; and the opportunities for collaboration with the private sector that derive from its location at the Nebraska Innovation Campus and the University’s established relationships with the private sector.

Taking into account these basic assets as well as the way in which the institute has defined its mission and approach, six comparative advantages of WFI stand out.

First, WFI is unusual among U.S.-university based institutes in that its goals include both research and research-related activities and outputs, and applied and impact-related outputs. WFI’s research, education, and engagement goals are achieved through collaboration with the distributed NU faculty with expertise in water and food, as well as through WFI staff and external partners. In particular, the explicit service goals of the Institute, though closely related to the land grant mission, are unusual.

Second, the Daugherty grant provides WFI the ability to build new partnerships and initiate projects much more quickly, and with more flexibility, than most university-based institutions. In particular, the Institute can effectively facilitate faculty research through administrative, logistical, technical, and marketing support. We can also use our staff and intern expertise to pilot new activities and programs rapidly as new opportunities emerge.

Third, WFI’s location in the High Plains provides access to a unique natural climate, hydrology, and policy laboratory for studying issues around water and food security. The Institute is located in one of the world’s most important food-producing areas. Nebraska has a history of innovation in agricultural technology, and Nebraska’s Natural Resources Districts are world-leading water governance institutions. A key WFI objective is to work both locally and globally. We are the bridging institution between local and global experts on water for food, bringing people from around the world to showcase innovations in water technology and management institutions in Nebraska, while using our global partnerships and knowledge to improve water and food security in the High Plains.

Fourth, WFI is able to build strong collaborations with a broad range of private sector partners, and such partnerships are a key component of our strategic plan. Our established relationships with Nebraska companies, frequent interactions with private sector partners at Water for Food Conferences and other venues, and our location at the Nebraska Innovation Campus, are all designed to promote public-private research and development in food, water, and fuel. Importantly, our intent is to build a broad variety of public-private partnerships that include collaborations with established industry partners, for-profit

entrepreneurs, social entrepreneurs, and non-profit partners. Collaborations will provide important professional development opportunities for WFI-affiliated students, faculty, and staff.

Fifth, as signaled by its name, WFI focuses sharply on the use and management of water by and for agricultural and food systems. While there are other U.S.-university based “water” centers and institutes, WFI is different in its focus on the water/food nexus and water and food security.

And sixth, WFI can bring to the table both the expertise of the University of Nebraska in a range of disciplines related to water and food as well as a growing infrastructure of external partnerships with key national and international organizations that give it access to additional expertise.

Our Shared Values

The following values guide the institute’s efforts to achieve its mission and vision:

INTEGRITY to build a trusted reputation for intellectual honesty. We provide unbiased information based on scientific principles.

LEARNING through university-based research and project development. We are willing to take risks and accept failure as part of the learning process and share knowledge with others.

SERVICE to our stakeholders in a manner of respect, empathy, equality and understanding. We uphold the teaching and extension values of the land grant universities.

EXCELLENCE in everything we do. We focus on quality, accuracy and are fully accountable and transparent in presenting the results of our efforts.

TRANSFORMATION of ideas to create innovative, visionary solutions. We believe we can be a catalyst for change in collaboration with our partners.

Our Subject Areas of Focus

When it was first established in 2010, WFI did not identify specific subject areas on which to focus its work. Instead, the institute took an exploratory approach, which allowed it to experiment with different topics, make discoveries and learn lessons that would help in developing a focused direction that made the most of its comparable advantages. In this way, the institute was able to advance its program while at the same time generate the lessons and experience needed to develop a clear strategy and operational plan at a later stage.

Now, in this second stage of its development, WFI has the knowledge and experience to identify the specific topics on which it can make a difference. To maximize its strengths, it concentrates on a manageable number of themes of global and local priority that it can pick up quickly and effectively. In doing so, it draws on expertise, capacities and opportunities at NU and its global network of partnerships and Associate Faculty, building on the results of the activities and programs initiated in its first five years (see “Five Year Growth Report: From Inception to Global Influence”).

Specifically, WFI concentrates its research, policy and educational work on the subject areas of global and local priority identified on pages 2-3 of this document:

Closing water and agricultural productivity gaps: WFI contributes to local and global efforts to close productivity gaps in rainfed and irrigated crop and livestock systems in order to improve rural livelihoods and incomes. These efforts include both the management of ‘blue water’ in irrigated agriculture and the management of ‘green water’ in rainfed agriculture through conservation agriculture and other measures. Clearly, a range of agronomic, water, climate, social, economic and institutional factors contribute to water and agricultural productivity gaps. However, WFI will initially focus on building on the pioneering work of the Global Yield Gap and Water Productivity Atlas as well as the University’s expertise in plant breeding

and biotechnology development, drought monitoring, and management and use of geospatial technologies. Specific activities include, for example, using remote sensing to monitor and predict yield and water productivity levels in real time and working to develop site-specific options to close identified gaps both locally and globally; implementing innovative projects in partnership with the private sector and social entrepreneurial groups, such as the CIRCLES project; and advancing agricultural science innovations to improve drought tolerance and crop water productivity. Yield gap analysis is an excellent opportunity to use skills available at NU and in Nebraska to solve problems in the developing world. Importantly, the yield gap analysis can be used to make the business case for specific interventions. Special opportunities exist in this area for WFI to be a catalyst to leverage existing resources at the University of Nebraska, including UNL's Food Science and Technology Department and Biological Systems Engineering and their interest in water use in post-production processes, and the UNL Panhandle Research and Extension Center in Scottsbluff with expertise in livestock production.

Groundwater management for agricultural production: The work here aims at improving groundwater management, drawing on the experience in this area of the State's institutions and producers, as well as the University's technical and policy expertise in the subject. WFI's work in this area focuses on scientific and policy research to improve understanding of the dynamics of linked human and natural components of groundwater, providing analyses, information, and tools that respond to stated stakeholder needs for advancing the management of groundwater systems. Given WFI's location, a key focus is on groundwater management in the High Plains region, and using the results of this work to inform scientific and policy research on groundwater management worldwide. The goal here is to establish WFI and NU as world leaders in scientific and policy research in the area. Products resulting from this initiative include reports and analyses about specific institutional innovations used by Natural Resources Districts to address important groundwater management issues. Work on groundwater management requires special attention to the "water-energy-food nexus" to understand the connections between water and energy use and agricultural production, and how different management approaches impact the human and environmental outcomes of these intersecting areas.

Enhancing High Productivity Irrigated Agriculture: Work in this area focuses on achieving high productivity in irrigated systems for optimal agricultural production and resource management under different scenarios, building on the expertise in irrigation engineering and water management available at UNL and our partners in the state and worldwide. Work includes for example using remote sensing to monitor and predict yield and water productivity levels in real time and implementing innovative projects in partnership with the private sector and social entrepreneurial groups in Sub-Saharan Africa. Work includes research, technology transfer, and education and outreach to further the goal of increasing water productivity in all forms of irrigated agriculture. Taking into account that the appropriate irrigation technology to use in any region is context specific and depends on multiple physical, environmental and socio-economic variables, topics include solar powered pumping for small wells, drip and center pivot systems for small-holder and large-scale production, deficit irrigation techniques, variable rate irrigation, and management and policy issues and governance. We have the opportunity to build a world-class recognized program for problem solving in irrigated agricultural development with strong partnerships and research projects in strategic countries to WFI and important agricultural regions of the world. One important dimension of this work relates to drought management and prediction. The importance of irrigation to guarantee crop production under drought conditions cannot be ignored. However, water resources are finite, so the development of techniques and methods to cope with drought should be considered when optimizing limited resources for crop production. These could include drought tolerant crop varieties, early drought detection using remote sensing, water management under drought conditions, and providing policy analysis surrounding risk management tools for deficit irrigation.

Freshwater and Agricultural Ecosystems and Public Health: WFI contributes to ensuring that efforts to improve water and food security also advance public health and ensure ecosystem integrity by bringing to bear the University's expertise in natural resources management; water quality analysis and technology; and public health. Work focuses on topics where there is particular expertise. Specific contributions could include building resilience to climate extremes; analyses of the health implications of water re-use for agriculture and of seasonality in water and food systems; systems approaches to better understand the unintended consequences of water/food policies on health; the interactive use of hydro-informatics and

population-based social/behavioral informatics tools; the use of Health Impact Assessments in addressing water for food issues; and studies of the impacts of floods and droughts on the health of vulnerable people, especially women and children. Special opportunities exist in this area for WFI to be a catalyst to leverage existing resources at the University of Nebraska, in particular the School of Natural Resources at UNL and the College of Public Health at UNMC. While this work is still in its very early stages, WFI aspires to develop it into a world-class recognized program for problem solving in ecosystems and public health aspects of water and food security.

In addition, the WFI works on a subject area of global and local priority focus (see pages 2-3) that cuts across the four other subject areas: the management of agricultural drought. In this subject area, WFI works closely with the NDMC, with which it has entered into a long-term affiliation agreement. Joint WFI-NDMC activities enable the globally-recognized work of the NDMC on drought monitoring and mitigation and on ways to reduce societal vulnerability to drought through preparedness and risk management to add value to WFI’s work on water and agricultural productivity, groundwater management, water conservation policies, and irrigated agriculture. An example of this kind of joint WFI/NDMC work is a recently approved USAID-funded project to develop a Regional Drought Management System (RDMS) for the Middle East and North Africa, which will focus on drought risk management through the development of monitoring and early warning systems, and preparedness and mitigation measures. The project, which also involves the International Center for Biosaline Agriculture and FAO, will serve the region by establishing a regional drought monitoring and early warning system and associated information delivery systems, providing assessment of drought vulnerabilities and impacts, and developing actions and measures to mitigate and respond to drought impacts. The RDMS will monitor regional drought conditions, assist with drought planning and coordination activities, and assist officials who are charged with relief efforts by providing “value-added” information during drought events.

Finally, in its work in Nebraska, the WFI works closely with the Nebraska Water Center, which is part of the WFI but focuses on a broader set of water issues of priority importance to the state of Nebraska, as defined by the University’s Water Resources Advisory Panel (WRAP) and other stakeholders. These priority issues include but are not limited to those relating to water use for food production, and encompass water quantity, water quality, and basin-specific issues. Key topical areas include impacts of climate and weather on water resources; understanding and protecting water quality; groundwater-surface water interactions; improving water efficiency in crop production; drinking water and wastewater quality and management; ecosystems, ecology and adaptive management; economic impacts of water management decisions; and human dimensions of water use. (See Figure 1.)

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

Figure 1. Interface between WFI and NWC activities. The green cell depicts the areas in which both WFI and NWC are active. The blue cell depicts the topical and geographical areas where NWC is exclusively active. The yellow cell depicts where WFI is exclusively active.

Importantly, all activities depicted in green in Figure 1 are co-branded as WFI/NWC activities, with both logos, regardless of whether WFI or NWC takes the lead. Activities depicted in yellow are branded as WFI activities, whereas those in blue are branded as NWC activities.

Our Geographical Areas of Focus

In carrying out its work in its subject areas of focus, WFI concentrates on geographical locations that provide the greatest opportunities to address its subject areas and/or have an impact and be effective. In its initial five years, these have been:

- Nebraska and the region surrounding it, i.e. the major food-producing heartland of the USA.
- India, China and Brazil, the big food producing countries that are also experiencing significant water stress and which are also priority countries for the University of Nebraska as a whole, as well as consumers and/or producers of the same main commodities as Nebraska
- A small number of countries within Sub-Saharan Africa, starting with Tanzania, where food security concerns are great and where better management of water is needed to improve food production.
- The Middle East and North Africa region (MENA), which is the area of greatest water scarcity in the world and where the University is involved through the MENA network of water centers of excellence and other activities.

Work in India, China and Brazil have provided opportunities to work on big problems that are important not only nationally but globally. Brazil also provides special opportunities to work with partners in educating the next generation of leaders able to deal with the country's huge water and food issues in a comprehensive way.

Importantly, the Institute seeks to ensure that its work in Nebraska benefits from WFI's global work and vice versa. Since WFI focuses on topics that are important both to Nebraska and globally, it is well placed to ensure synergy between the work it carries out globally and the projects it carries out in Nebraska.

WFI also takes specific steps to connect its work in Nebraska with its global work. Where relevant, WFI shares the results and outcomes of its overseas research and policy work with stakeholders in Nebraska, and helps to make Nebraska's experiences in each of its four subject areas better known in other countries. For example, WFI's first policy report focuses on Nebraska's experience in groundwater management and the Natural Resources Districts.

In its work both in Nebraska and internationally on issues in which we have a comparative advantage, WFI seeks to ensure that any innovations that it helps develop in Nebraska are useful overseas and vice versa, and that the skills WFI is able to draw on at NU and in Nebraska can be used to solve problems elsewhere (See Figure 1).

Program Strategy and Impact Model

The WFI program rests on three closely inter-related pillars – research and policy, education, and communication – all including a critical component of active engagement. Integral to the success of this work are strong partnerships to help us carry out our work and communicate results. All elements of our program contribute to our mission and lead to one or more specific plan period objectives. Institute activities are principally determined by demand, taking into account areas of faculty and partner strength and opportunities to make a difference.

Since the ultimate goal of the institute's impact-driven program is to contribute to advancing water and food security, its programs are designed not simply to produce useful outputs such as publications, websites and trained personnel, but more importantly, to achieve strong positive outcomes in terms of changes in knowledge, changes in action, and ultimately, changes in water and food security. The institute's programs therefore strive to connect immediate outputs to desired impacts through an explicit "output to impact" approach. For example, the research and policy work shared at conferences and workshops aims to lead to changes in knowledge of students, producers and decision makers. Work on engagement and communication aims to foster changes in knowledge that then change behaviors of key stakeholders, leading to changes in practices and policies at different scales. And partnership activities on

the ground, as in the CIRCLES project in Tanzania, aim at making tangible improvements in water and food security for the communities directly involved.

Active engagement is a critical component of WFI's program strategy that cuts across all aspects of its program activities. Engagement is a tool to build the capacity to get things done and achieve a defined objective, most often driven by the need of various individuals and entities to come together to achieve an objective that they would otherwise not achieve on their own. Our engagement work includes policy analysis, advisory services, decision tool development and knowledge delivery that use the results of scientific and policy research to inform policy and advise policy makers. It builds on the University's long-term commitment to service to the agricultural community and its expertise and know-how in extension services.

The Institute's programs address the overall challenge as articulated earlier in a number of different contexts, both locally and globally, at one or more scales from the field and farm scales to state and national scales.

- **Research and Policy:** WFI's research and policy programs focus on innovation in technologies and management practices and their practical application; they emphasize data collection, analytical thinking, evidence-based decision-making, and contextual contrasts (e.g. Nebraska and globally). Research encompasses both the critical application of the natural and social sciences to assess specific interventions (policy analysis) and the development of mechanisms and policy instruments to achieve policy goals (policy design) and focus on science-based policies that are firmly grounded in technical considerations.
- **Education:** WFI sees education, in both formal and informal settings, as building knowledge for now and for the future. In keeping with the Institute's mission, there is a concerted effort to educate the next generation and engage young talent. Our educational strategy includes a variety of delivery formats to best meet the needs of participants, including academic teaching, extension, web-based education delivery, seminars and workshops, special events and community outreach.
- **Communication.** WFI's research and policy work is advanced through communication. Communication facilitates research, policy development and education by sharing program outputs and outcomes with stakeholders in the U.S. and around the world. Audiences include: agricultural producers and other water managers; local, state, national and international decision makers; practitioners and decision makers in industry groups, private companies, non-profits and NGOs; faculty, scholars, and undergraduate/graduate students at NU and other educational institutions; and the general public. The Institute encourages data- and research-based policy dialogue in a variety of forums and at various levels, including at its annual Water for Food Conferences. Its communications works helps build relationships, using the most appropriate media and communication format, to position WFI as the preeminent US-based resource for sustainable water and food system research, innovation and education. WFI's communications strategy is closely aligned and coordinated with the communications activities of University of Nebraska Central Administration.

Within Nebraska, the WFI carries out its programs with the strong support of the Nebraska Water Center and the NWC's Water Sciences Laboratory. NWC's education, communication, and engagement programs help to make research results easily available. The NWC also carries out important liaison functions, including facilitating the University of Nebraska Water Resources Advisory Panel (WRAP) and providing research and other information as needed to decision and policy makers.

Institutional Strategy

From its inception, the vision for WFI has been that of a non-traditional institute that would operate as a creative network with several constituent parts, strengthened by national and global partners including

other universities, public sector institutions, private sector partners and NGOs. WFI's institutional strategy is thus based on the concept of the institute as a 'distributed institute,' with a core group of staff and drawing on faculty across all four campuses and disciplines of the University as well as its network of partners and affiliated faculty at other institutions, benefiting from the advice of both internal and external advisory bodies, and governed by a Board of Directors.

One of WFI's strategic objectives is to be a catalyst in leveraging the University's faculty and specialized centers and programs as well as its global partnerships and affiliated faculty at other institutions, to advance its mission. For example, the presence and national and international recognition of the National Drought Mitigation Center at UNL provides an opportunity to multiply impact and influence and increase effectiveness in this vital aspect of water and food security. Likewise, the institute's Faculty Fellows can be a catalyst to increase the institute's impact. So part of WFI's institutional strategy is to expand the number of faculty involved in its work, drawing in more people with relevant expertise to further advance its mission and increase its circle of influence.

An important question that arises in this network context is the definition of what constitutes the Institute's work. The Institute has considered this question carefully, and has defined its core work as the combined activities of the WFI core staff and University faculty and specialized centers that occur as a result of the institute and that would not have otherwise happened (i.e. where there has been some added value from WFI). In addition to its core work, the Institute also serves as an "intellectual umbrella" to help advance the broader work of the many faculty addressing water/food issues locally and globally who share its vision and contribute to its mission.

WFI Core

The core administrators and staff, i.e., the "WFI core," have a central role in raising funds and in supporting faculty affiliates to do so, in communications and public relations, and in establishing, maintaining and servicing partnerships. While the Faculty Fellows (see below) constitute the "heart" of the institute, WFI makes use of internal and external non-faculty staff, students, and affiliates to collaborate on applied research projects, and plans to increase such use in the future.

The WFI administrative core consists of the Executive Director and his/her leadership team, including the Directors of Research and Policy and the Director of the Nebraska Water Center, a small support staff, and a small group of International Research Fellows and Visiting Scholars. Importantly, the WFI core also includes the staff of the NWC, who focus on engagement with Nebraska water, agriculture and natural resources stakeholders, and the Water Sciences Laboratory. The WFI and NWC core staff are located at the Nebraska Innovation Campus – one of the first groups to be located there when the Nebraska Innovation Campus was inaugurated in 2014.

Affiliated Centers

The institute's first affiliated center is UNL's National Drought Mitigation Center (NDMC), whose expertise in the reduction of societal vulnerability to drought complements well WFI's expertise in agricultural water management, including long-term water conservation, water productivity, groundwater management, irrigation, drought tolerant crop varieties, early drought detection using remote sensing, and water management under drought conditions. WFI and NDMC work closely together to provide an integrated approach to drought management combining drought monitoring and mitigation with agricultural water management. An excellent example of this collaboration is the ongoing joint work with FAO and other partners to develop a Regional Collaborative Platform to address water consumption, water productivity and drought management in agriculture in the MENA region.

Affiliated Faculty

As a distributed institute drawing on the expertise of the entire University of Nebraska system, the faculty members affiliated with the Institute are integral to its success. Accordingly, WFI has given priority to

developing creative internal arrangements in its approaches to faculty affiliation, in order to increase capacity for innovative research.

In particular, WFI has created a structure for faculty affiliation based on the designation of “Faculty Fellows” at NU and other institutions that is well suited to its mission, building on successful models within the NU system. Faculty Fellows are faculty members at NU who identify with the Institute’s mission and vision and are actively involved in WFI programs (e.g. by receiving WFI competitive grants funding, collaborating with WFI on developing and submitting grant proposals, or holding positions supported directly or indirectly by the WFI). (A critical component of the Institute’s affiliated faculty is the WFI faculty ‘cluster hires’, who were recruited specifically to contribute to WFI’s work and who are beginning to play an important role in the Institute’s programs.) Associate Faculty Fellows are faculty at other universities and research institutions in the US and abroad who contribute to the Institute’s research, scholarship, engagement and education programs for a sustained period of time. While the range of expertise of the Faculty Fellows is diverse, all contribute in one way or another to the Institute’s research and policy and/or its education and engagement activities.

Governance and Advisory Bodies

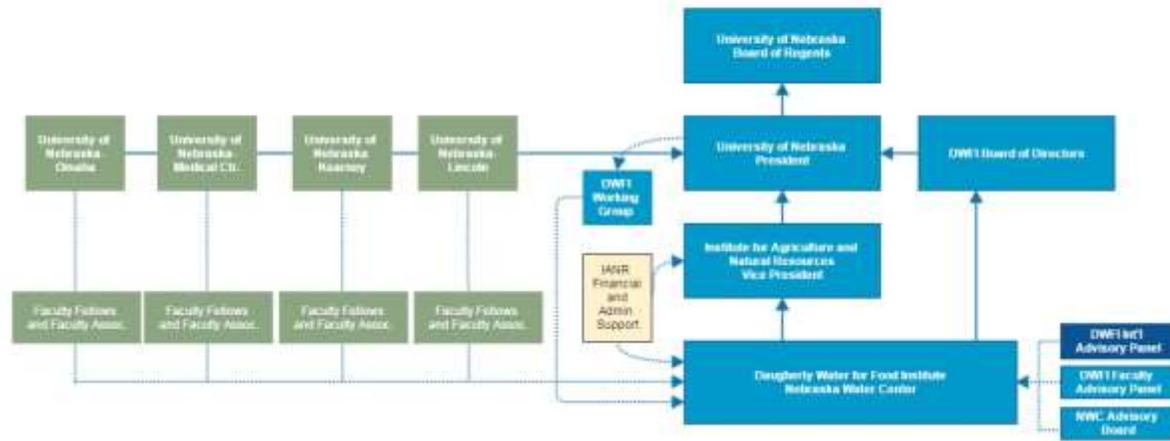
The WFI is governed by a Board of Directors appointed by the President of the University of Nebraska and which currently includes the CEO of the Robert B. Daugherty Charitable Foundation, the former CEO of the Bill & Melinda Gates Foundation, and the Chancellor of the City University of New York. Within the University of Nebraska, the WFI Executive Director reports to the Vice President for Agriculture and Natural Resources of the University of Nebraska, who in turn reports to the President.

The Institute has put in place internal and external advisory bodies. Internally, the Institute’s Executive Director benefits from the advice and support of an internal Working Group, which includes the President and senior leadership of the University and which meets quarterly, and a Faculty Advisory Panel. Externally, the Institute is advised by an International Advisory Panel, which provides guidance to the Institute’s leadership on the research, policy and education programs of the Institute, and links the Institute with the expertise of outside specialists as well as the users of WFI’s products and services.

With respect to work in the State of Nebraska, the University as a whole is guided by the Water Resources Advisory Panel, established in 2006 to connect the University with outside experts and Nebraskan research users and other stakeholders. The NWC is guided by an advisory board made up of faculty and stakeholder agencies.

The figure below depicts these various bodies and the relationships among them and with WFI.

DWFI Governance and University of Nebraska Relationships



Global Assets and Partnerships

From its inception, the WFI was envisioned as developing cooperative research programs with organizations working nationally and internationally, to enable access to complementary expertise, extend its global reach, and amplify its impact, rather than trying to achieve its mission on its own. For these reasons, WFI strives to keep abreast of the work of other actors in its sphere of interest and collaborate with these actors where appropriate. Collaboration with private sector partners is particularly important in this context, given their important role in advancing innovation in agricultural, irrigation, information and food-processing technologies as well as WFI's comparative advantage in working with industry and the private sector.

Partnerships may be established to develop joint research and/or education programs, projects and proposals; collaborate on engagement programs, activities and events; or collaborate on faculty, staff and student support. Partner Organizations may be nominated by Institute administrators or current Faculty Fellows, or attain Partner status by collaborating extensively with Institute programs. Partner Organization status is established by the Institute Executive Director in collaboration with the leadership of the partnering organization and finalized through a partnership agreement. In some cases an existing memorandum of understanding or other agreement may serve as the partnership agreement.

Recognizing that the timeframe of these partnerships may extend over a number of years and will vary depending upon the nature of the agreement, the Institute will periodically review and assess the partnership with each Partner Organization. This review and assessment will occur every 12-18 months after the partnership formally begins and will focus on how the terms of the agreement are being met. Modifications to the agreement may occur at this time.

As indicated earlier, in its first five years WFI has entered into formal agreements with several organizations, including with private sector partners such as Jain Irrigation and the Global Harvest Initiative. In carrying out its research and education and engagement activities, WFI builds on these strategic partnerships, always emphasizing its unique role, to amplify its impact instead of trying to do everything itself.

Financial Strategy

The institute was established with a \$50 million gift from the Robert B. Daugherty Foundation (RBDf) to be spent over a 15 year period beginning in 2010. The institute also receives significant in-kind support from the University of Nebraska as well as funding from external sources, including those from

competitive federal funds. A critical question for WFI is how best to leverage the initial grant from the RBDF to achieve its longer-term mission. The Daugherty grant provides about \$3.6 million a year for the next 10 years. This funding represents an important comparative advantage of WFI, as it can be used as seed or cost-share funding for larger endeavors, as well as to provide administrative and logistical support. However, WFI's size should be driven by the kind of impact desired; growth is not an end in itself.

WFI's goal by 2020 is to develop a portfolio of programs that involve a variety of partnerships, engaging with and serving the needs of our full set of identified stakeholders within and outside of the NU system. Our goal is that each of our programs will have collaborators – whether our own fellows or external partners – that contribute to the program through a combination of expertise, time, and funding. Where appropriate, our programs will seek competitive federal research funds, contracts, and cooperative agreements. Other programs may be better suited to contracts from the private or non-profit sectors, or gifts.

Our goal by 2020 is to have an external funding portfolio with active awards in each of the following categories: competitive federal funds; collaborative agreements with local, state, federal and international organizations; joint ventures with private and non-profit groups; and gifts (in addition to the Institute's founding gift). Additionally, our goal over time is to fund a greater proportion of WFI's administrative costs and program expenses from our external funding portfolio. WFI tracks and reports funding and resources provided to each of our programs, as well as funds raised by program activities and associated outputs and impacts.

During the 2015-2020 period, WFI's objective is to bring in a roughly equivalent amount to that provided by the RBDF on an annual basis. However, we want to ensure that the flexible funding from the Daugherty grant remains a significant proportion of our overall funding in order to maintain our ability to undertake innovative programs with a variety of partners.

WFI is mindful of the need to ensure financial sustainability beyond the initial 15-year period of the RBDF's initial grant. Working closely with the University of Nebraska Foundation, the institute is developing a plan for long-term financial sustainability. This plan includes building a substantial endowment fund for the Institute, starting with the development of a \$3 million matching endowment fund to support work in the area of education using \$1.5 million in carry-over funding from the period 2010-15.

Measuring and Evaluating WFI Outputs and Impacts

In considering ways to measure and evaluate the institute's outputs and impacts, it is important to take into account that the financing of the institute comes from WFI's external funders and the University itself. While WFI's external funders are principally interested in WFI's external impact, the University of Nebraska is also concerned about the institute's internal impact on the growth and development of the University. WFI's outputs and impacts can thus be viewed as having both internal and external components, challenging the institute to always look for ways to increase external impact while at the same time having a positive impact on the University itself.

In evaluating itself in terms of real external impacts, the Institute defines outputs as measurable products (e.g. websites, publications, trainees) and outcomes as "stories" that demonstrate a change in knowledge (e.g. participant learning or awareness), action (e.g. participant behavioral change), or condition (e.g. change in societal or resource condition due to participants' actions). While the benchmarks established for the first five years were primarily 'input' benchmarks – staff hired, funds generated – the benchmarks for the second five-year period focus on outputs and outcomes as well as inputs.

In generating and describing outcomes, WFI works to state clearly the specific issues being addressed by our research and education activities and the intended audiences and stakeholders. This allows us to demonstrate a progression from issues to activities undertaken, and hence to outputs and outcomes involving well-defined stakeholders. Outcomes are the result of measurable indicators, so that WFI can report what was achieved as a direct result of its involvement.

While overall WFI works to identify problems and help solve them in specific contexts, as part of the University of Nebraska it recognizes the need for basic as well as applied science and to build on the investments that NU has already made in both basic and applied science. WFI also recognizes that the fundamental science questions regarding food and water require an integrated, interdisciplinary approach.

WFI evaluates its internal impacts principally by monitoring the extent to which it is successful in involving faculty and students with the work of WFI and thus generating a constantly expanding sphere of influence and engagement within the university. In its reporting, WFI provides data on the number of faculty and students engaged in its programs.