

CATALYTIC COLLABORATIONS

Building Public-Private Partnerships for Water and Food Security

Proceedings of the 2016 Water for Food Global Conference
Lincoln, Nebraska, USA | April 24-26



UNIVERSITY OF
Nebraska



Water for Food
GLOBAL CONFERENCE
at the University of Nebraska

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Foreword

The Water for Food Global Conference has become one of the preeminent international conferences for people around the world who are working on the universal challenge of achieving water and food security.

The seventh conference, “Catalytic Collaborations: Building Public-Private Partnerships for Water and Food Security,” focused on the powerful innovations that can result from partnerships. From the very beginning, the Robert B. Daugherty Water for Food Global Institute at the University of Nebraska has worked to develop vital partnerships across all sectors to develop solutions and avoid duplication of existing efforts.

There is power in partnerships. In addition to civil society and public sector organizations concerned with water and food security, a range of private sector groups have a strong commercial interest in improving water security and increasing food production, such as seed companies, irrigation manufacturers, technology startups and food processors. Forging partnerships to bridge the public and private worlds magnifies the impact of their contributions.

By working together — large, multinational corporations, non-governmental organizations, small startups, think tanks, universities and others — we are able to cultivate innovative R&D solutions through a synergistic blend of expertise, strengths and perspectives, while mitigating risk and sharing resources. Yet, despite considerable advantages, public-private partnerships (PPPs) are not a one-size-fits-all solution and are not always the best way to achieve goals.

As you’ll see in the proceedings, the conference provided many perspectives on PPPs and initiated discussions on topics that will continue to evolve through further research, as well as continued international dialogue at other important conferences, such as World Water Week in Stockholm and the 2018 World Water Forum in Brasilia, Brazil.

From its deep roots in Nebraska, the Water for Food Global Institute is sharing knowledge and leveraging the University of Nebraska’s expertise to help meet the demands of our growing world and changing climate. We hope this report will shed light on how PPPs can play a valuable role in advancing water and food security.



Jeff Raikes

*Co-founder, Raikes Foundation
Chair, Water for Food Global Institute Board of Directors*



Preface

I am pleased to introduce the proceedings of the Seventh Water for Food Global Conference, “Catalytic Collaborations: Building Public-Private Partnerships for Water and Food Security.” In association with the Bill & Melinda Gates Foundation, we welcomed more than 360 individuals from throughout the U.S. and nearly 15 countries to our signature event. For the first time, the conference was held at Nebraska Innovation Campus in Lincoln — a fitting place given this year’s emphasis on collaboration. The conference sparked three days of discussion surrounding the major aspects of leveraging public-private partnerships (PPPs) to address our world’s pressing water and food security challenges.

Against this background, the 2016 Water for Food Global Conference focused on the impacts of innovation-focused PPPs toward improving water management and agricultural productivity. The program explored successful models of PPPs around the world, as well as possible challenges and pitfalls.

We began with a workshop on the “Opportunities and Challenges of Expanding Smallholder Irrigation in sub-Saharan Africa,” co-convened by the Gates Foundation, KickStart International and the Water for Food Institute; in partnership with CGIAR Research Program in Water, Land and Ecosystems.

The conference provided an excellent opportunity to introduce Peter McCornick as the institute’s incoming executive director. Peter will officially take the helm on Aug. 25 after serving as deputy director general of research at the International Water Management Institute, the world’s foremost international research institution dedicated to improving management of water and land resources in developing countries to ensure food security and reduce poverty.

As you’ll discover in this report, conference participants examined:

- Irrigation research and technology for smallholders, including remote sensing and apps that help farmers target water usage to maximize yields
- Agricultural solutions in both crop development and management; and livestock

- Information technology to improve water and agricultural productivity
- Food processing advancements to reduce water use in the food and beverage sector
- Public health and its important role in water and food security
- The role of social entrepreneurship projects as PPPs

In addition to an ambitious schedule of plenary speakers, panel discussions and world café-style sessions, participants enjoyed the world premiere of the documentary film, “Thirsty Land;” a student poster competition; a photography competition and exhibit; a farm-to-table dinner and a closing reception with live Brazilian music.

As I reflect on my final conference as executive director, I am honored to have been part of an organization that is truly a global leader in bringing together the brightest minds in the food and agriculture sectors to foster education and collaboration, drive new ways of thinking and catalyze change to push us closer to achieving water and food security, now and in our future.

In closing, I wish to express my appreciation to our staff, collaborators and partners for their tremendous efforts in planning and executing the conference. I would also like to thank the Robert B. Daugherty Foundation, the Gates Foundation and our corporate sponsors for their generous financial support of the conference.



Roberto Lenton

*Founding Executive Director,
Water for Food Global Institute at the University of Nebraska
August 15, 2016*



INTRODUCTION



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Introduction

“Complex challenges demand collaborative approaches,” said University of Nebraska President Hank Bounds. “Let me be clear: the water for food challenge is not just complex; it is, in my view, the single most urgent challenge facing the world today.”

World hunger and thirst define the future of global prosperity and stability, Bounds and others articulated throughout the 2016 Water for Food Global Conference. Access to quality food and water is intrinsic to health and well-being, household livelihoods and community vitality. Yet 800 million people are malnourished and billions live with water scarcity, according to the United Nations. The world’s population is expected to expand by another 25 percent, reaching 9.6 billion by 2050. Food production must more than double to meet rising demand, while using less water resources.

No one country, international agency or societal sector can overcome this enormous challenge. Pat Mulroy, of the Brookings Institute, was perhaps most emphatic: “I am an incredibly strong believer in the power of partnership. We all are in this together, and one of us will not come out a winner while the rest are losers.”

The conference highlighted a variety of successful partnerships, among governments, public and private sectors, academia and others. But presenters also explored how to develop and use partnerships more effectively, particularly to advance technology and to bridge the technological and institutional spheres.

Global Challenges

To double food production, the agricultural community can’t simply do more of what’s been done, said Peter McCornick, incoming executive director of the Water for Food Global Institute. As economies expand, diets change. People demand more water-intense protein sources and pay greater attention to nutritional value. Food security is no longer about single



Hank M. Bounds, president, University of Nebraska

commodities — the wheat, rice and corn staples that feed the world’s poor, he said. Meeting nutritional requirements binds agriculture with health more tightly, necessitating greater collaborations among disciplines.

McCornick described global factors exacerbating the water for food challenge. Several countries have long been over-abstracting their underground water resources, and the consequences of unsustainable use already harms food production in many areas due to lack of water, soil salinization and other issues. Climate change is also causing enormous problems as droughts increase in frequency and intensity, sea levels rise and pest biology changes, among other challenges. Illustrating local consequences, the documentary “Thirsty Land” described how the extreme drought and unsustainable water use in the western United States challenges farmers, local communities and the environment.

Women’s roles in water for food were also frequently raised. Women increasingly

“This is not a static situation. This is a situation that if we do nothing, if it’s business as usual, we actually go backward.”

—Peter McCornick

bear the responsibility of food production in Africa and elsewhere, particularly as men migrate to cities for jobs. Yet women often are relegated to less productive land and have less access to resources. Development solutions, such as small-scale irrigation, don’t improve women farmers’ lives unless interventions directly support them, said Claudia Ringler, of the International Food Policy Research Institute (IFPRI).

Globally, the importance of water resources is garnering greater attention, McCornick said. The World Economic Forum considers water availability one of the highest global risks, and water resources play a clear role in the recently created Sustainable Development Goals. “Food security relies on investing in water,” he said. “This is not a static situation. This is a situation that if we do nothing, if it’s business as usual, we actually go backward.”

Power of Partnerships

The conference explored the ability to innovate in new and influential directions through collaborations. Working across sectors and scales, collaborators are able to achieve more together than any one group can alone. Partnerships between the public and private sectors, in particular, offer unique opportunities.

Sally Rockey, of the non-profit Foundation for Food and Agriculture Research (FFAR), described what it takes to make public-private partnerships successful. With public funding for water and agricultural research diminishing, she urged the public sector to embrace working with private entities as a means to gain additional resources and to reach goals sooner.

Panelists discussed how they use and benefit from public-private partnerships.



Sally Rockey, executive director, Foundation for Food and Agriculture Research



Peter McCormick, executive director-elect, Water for Food Global Institute

Companies — from multinational companies to small startups — highlighted products, programs and new directions developed through a variety of partnerships.

Representatives from governmental organizations, including Rockey's FFAR, the U.N.'s Food and Agriculture Organization and the U.S.-based Millennium Challenge Corporation, described how establishing partnerships with international governments, academia and others are often at the core of their operations.

And the audience heard about how collaborations among farmers, regulators and agribusinesses have helped the state of Nebraska achieve sustainable use of the High Plains Aquifer, during the popular "View from the Field" session.

Other partnerships were also highlighted. Jeff Raikes, co-founder of the Raikes Foundation, demonstrated how philanthropy can step in to catalyze innovation when the public and private sectors are unable or unwilling to act. UNL's Elizabeth VanWormer described One Health, an academic approach that connects human, animal and ecosystem health and operates through numerous partnerships to achieve holistic solutions. And Pat Mulroy told the

riveting story of how one river community in the western U.S. survived the worst drought cycle on record thanks to a hard-fought and complex intergovernmental partnership.

Speakers also emphasized the importance of focusing on value chains that create markets for farmers' produce. Anil Jain, managing director of Jain Irrigation Systems, described his company's evolution from selling drip irrigation systems to providing a complete value chain of agriculture, ensuring farmers a market for their products.

Water markets as a potential solution to incentivize water conservation also was addressed. Richard Sandor, chairman and CEO of the Environmental Financial Products, cited increasing global conflict over water, and by implication food prices, to help make the case for establishing water markets.

Irrigating Africa

Africa, the most food insecure place in the world, received particular attention. Presenters expressed broad support for developing smallholder irrigation in sub-Saharan Africa. "The potential to use irrigation and good water management as a transformative initiative for smallholder farmers in Africa is tremendous," Raikes said.



Martin Fisher, co-founder and CEO, KickStart International

Irrigation could lift tens of millions of rural Africans out of poverty, agreed Martin Fisher, co-founder of the non-profit KickStart International. He led “Opportunities and Challenges of Expanding Smallholder Irrigation in Sub-Saharan Africa,” a workshop that explored irrigation’s potential. Small-scale irrigation transforms subsistence rainfed farms trapped in yearly feast-to-famine cycles into diverse, profitable businesses, he said. It also reduces risk, incentivizing further investments in farm improvements. And, as farmer incomes improve, the economic benefits ripple out to communities with better education, business opportunities and greater food security, locally and regionally.

Only 5 percent of Africa’s cultivated land is irrigated, compared to 20 percent globally. It’s not for lack of water. IWMI’s Karen Villholth reported on a study that found sub-Saharan Africa has ample sustainable groundwater resources available for irrigation.

The workshop engaged the audience in developing a plan for moving forward. Solutions included developing affordable technology, securing strong policy support, linking irrigation with the energy sector, and applying a market-based lens involving the private sector.

The private sector must include smallholder farmers, who are motivated by profitability. They will invest in irrigation when they see clear a benefit. “In the end, it’s the profitability for the smallholder that is going to be the driving force behind all of this,” said Roberto Lenton, Water for Food Global Institute (WFI) founding executive director.

Above all, sub-Saharan Africa needs an irrigation champion and a platform to coordinate efforts, participants advocated. A champion could collaborate across sectors, aid communication and data sharing among different stakeholders, promote needed research and coordinate investments.



Weeding maize in India

Technology

Technological advances continue to play a crucial role in boosting food and water security. New technology and innovations were on display throughout the conference, a continuation of the big data topics highlighted at the previous conference in Seattle, Washington, USA. Panel sessions, in particular, highlighted key innovations in water for food, including agricultural and irrigation technology, information technology and reconditioning water used in food processing.

Technology is also creating vast amounts of data. Presenters described the benefits of big data, including the promise of significant yield advances. But they also discussed the challenges of harnessing data and applying it on the farm. Several presenters also acknowledged that, though tools that improve farmers' yields exist, adoption rates are extremely low. Suggestions for increasing adoption rates included creating farmer incentives, making technology easier to use and creating benchmarks for farmers to compare their performance.



Roberto Lenton, founding executive director, Water for Food Global Institute

PARTNERSHIPS



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Partnerships

Water and food insecurity has proven stubbornly resistant to change. However, collaborative efforts among the public, private and civil sectors have delivered progress in this and other complex global problems. Working together, the three sectors are often able to accomplish more than any one sector can alone. Successful collaborations also benefit participants, from mitigating risk to sharing financial, political and technological resources.

The conference focused much attention on public-private partnerships, but other successful collaborative partnerships were also highlighted.

Public-Private Partnerships

Despite the importance of food to quality of life, public funding for agricultural research has been stagnant, said Sally Rockey, during her plenary presentation. Funding from industry has eclipsed the public's contribution so establishing new relationships would generate new funding sources and deliver research results to the public domain.

"That is where the action is, folks," Rockey said. "We need to continue to move in that arena, not only because we share goals with the private sector, but because that's also a place where there could be joint funding of research."

She heads the Foundation for Food and Agriculture Research, a nonprofit, governmental organization created through the 2014 U.S. Farm Bill to support a broad range of scientific research. FFAR operates by establishing public-private partnerships.

The key to successful partnerships, Rockey said, is to work in the pre-competitive space, where outcomes benefit parties equally and resources can be shared. For-profit companies, from multinational corporations to small startups, are able to address concerns or obstacles common in the industry, save costs and obtain important fundamental research. The public sector, in turn, has greater access to

financial resources, expertise and data. These advantages allow efforts to reach society sooner.

She described several requirements public-private partnerships need to function well, including shared goals and values, mutually agreed upon rules and responsibilities, and trust. Partners must also share responsibility for failures.

Panelists in the "Industry Panel," in particular, highlighted the benefits of public-private partnerships to their companies. Robert Meaney, formerly of Nebraska-based Valmont Industries, said shared values and a commitment to advancing irrigation technology prompted the global irrigation company to develop partnerships with industry, academia and governments.

Partnerships with international agencies also help Valmont better understand global markets. In Africa, Valmont center pivots irrigate 1.5 million hectares of large commercial farmland, primarily in South Africa. But the company is exploring ways to bring center pivots to smallholder farming systems as well, Meaney said. For example, it recently worked with the Rwandan government to install more than 40 center pivots in a smallholder region, organized using an existing co-op structure. And in a pilot program in Tanzania, Valmont is collaborating



From left: Michael W. Willer, Chris Tingle and E. Robert Meaney on the "Industry Panel"

with non-profit World Vision and WFI to equip a farming community with a center pivot irrigation system.

“Because we’re in the irrigation space, we’re dealing with the common good, and there are a lot of technical and social reasons that we have to be open to many different partnerships and relationships,” Meaney said.

Anil Jain, of Jain Irrigation Systems, described how his company and the Indian government are improving India’s rural economy. An initial drip irrigation system costs up to \$1,500 per hectare, a sizable investment for poor farmers. Yet drip irrigation doubles yields using half the energy, fertilizer and water the government already subsidizes. So the government began investing in farmers’ drip irrigation systems, paying about half the cost.

“As a combined approach, today the farmer balance sheet is far better, government balance sheets are definitely better and our company has grown,” Jain said. “In terms of impact created, I would venture to say that this is one of the most beneficial programs ever created for agricultural farmers in India.”

The “View from the Field” panel — featuring a Nebraska farmer, industry representative and regulator — illustrated the collaborative nature between public and private sectors that has helped the state balance the needs of agricultural production, businesses and the environment.

The panel discussed Nebraska’s Natural Resources Districts, established in 1972, are locally elected governing boards organized around river basin boundaries. The boards have broad powers, including taxation and regulatory authority, and are responsible for governing Nebraska’s vast groundwater resources.

The North Platte NRD works closely with producers and industry partners to meet its regulatory obligations without overreaching, said panelist John Berge, general manager of North Platte NRD. All three groups recognize that if obligations fall short, stricter measures could be imposed. “We want to slow walk and staircase regulation so that we’re not hindering the ability for people to continue to have an economically feasible operation,” Berge said.



Anil B. Jain, managing director, Jain Irrigation Systems, Ltd.

The regulatory agency also plays an extension role, he added. By developing relationships with research centers and private industry, NRDs act as a conduit to farmers, bringing technologies that improve water management.

As collaborative as Nebraska’s groundwater stakeholders are, all three panelists said they see room for improvement. Incorporating surface water management into larger water regulations could help meet groundwater obligations and improve surface water efficiency, Berge said.

Farmer Roric Paulman said he’d like to see academic research reach the field sooner. Owen Palm, of 21st Century Equipment agreed. Understanding how technologies could best serve producers and meet regulatory requirements requires better communication and collaboration, he said. With little rain in western Nebraska, “we have to work with all of these different parties to figure out the best way to minimize our consumptive use and maximize our production.”

Catalytic Philanthropy

Both the private and public sectors play important roles in society, said Jeff Raikes, co-founder of the Raikes Foundation, during his



Anil B. Jain, managing director, Jain Irrigation Systems, Ltd; Jalgaon, India, accepts an award from University of Nebraska President Hank Bounds in memoriam of Bhavarlal Hiralal Jain, beloved founder chairman of Jain Irrigation. Also pictured (from left): Tom Farrell, Ronnie Green, J.B. Milliken, Christopher Neale, Roberto Lenton and Jeff Raikes.

Bhavarlal Hiralal Jain Dedication and Memorial

A special award was bestowed to Anil B. Jain, managing director, Jain Irrigation Systems, Ltd; Jalgaon India, in memoriam of Bhavarlal Hiralal Jain, founder chairman of Jain Irrigation — a true

champion of agricultural water management. Jeff Raikes presented the award, along with the Water for Food Global Institute’s board of directors and leadership.

In 2013, WFI established a Memorandum of Understanding with Jain to develop new approaches to improve “crop per drop” in India through practical, multi-disciplinary research, education, outreach and capacity building programs. In 2015, Jain Irrigation entered into a grant agreement with the University of Nebraska Foundation, donating resources to support scientific research and educational exchanges in those priority areas.

In honor of Jain’s leadership of an evergreen revolution in agriculture through responsible research, sustainable use of resources and inclusive engagement of farmers, scientists and business leaders, the University of Nebraska named the Nebraska-Jain partnership in research and training the Bhavarlal Hiralal Jain/University of Nebraska Water for Food Collaborative Program and the participating scientists and students the B. H. Jain Scholars and Fellows.

plenary presentation. But for many stubborn world problems, gaps exist between market failure and society’s ability to step in, which limits progress. “This is where I see the sweet spot for what I call catalytic philanthropy,” he said, a term coined while he was CEO of the Bill & Melinda Gates Foundation.

To drive societal change, catalytic philanthropy identifies innovative interventions that neither private companies nor public agencies will take on, assembles the evidence of the intervention’s efficacy and makes the case for market viability. “It is a way, in my view, to get much greater leverage on behalf of society to address these kinds of societal challenges,” Raikes said.

He cited WFI as an example of catalytic philanthropy. Launched by a \$50 million gift from the Robert B. Daugherty Foundation and University of Nebraska resources, the institute has initiated a wide range of projects with numerous academic, public and private partners to tackle a major global challenge.

The Alliance for a Green Revolution in Africa was also formed through catalytic partnerships among academia and support from the Gates Foundation. While its first 10 years have produced tremendous innovations in breeding capacity, it must now work with partners to ensure those innovations reach Africa’s 100 to 250 million smallholder farmers, Raikes said. That goal requires

identifying market failures and other barriers preventing a sustainable market system. “What AGRA has to do,” Raikes said, “is they have to think in another dimension of catalytic activity.”

Collaborative Research

Raikes’ examples also illustrate the growing emphasis on partnerships within academia. UNL’s Elizabeth VanWormer highlighted another catalytic approach called One Health, which explicitly links human, animal and environmental health. This concept engenders a holistic approach, one that brings together diverse disciplines, from ecologists and agronomists to economists and sociologists, she said during the “Mitigating the Effects of Climate Change” session. Beyond academia, One Health engages governments, non-governmental organizations, the private sector and the community.

“We really need to stretch ourselves, I think, and to reach beyond our traditional comfortable silos in order to address these

really global problems,” VanWormer said.

She described a One Health project working with pastoralist communities in Tanzania that brought together an extensive list of specialists, from community developers to veterinarians and agriculturalists. They teamed up to address the community’s concerns regarding emerging livestock diseases and access to pasture and water for livestock. In addition to investigating linkages among livestock, human health and livelihoods, the team analyzed political, economic and environmental influences. Recommendations encompassed the entire human, animal and ecosystem network, thereby better addressing underlying mechanisms and balancing the needs of each sector, VanWormer said.

Fellow panelist Jon Padgham, of the U.S. non-profit START, described another large collaborative effort, “Adaptation at Scale in Semi-Arid Regions,” that uses a broad-based approach to research and implement climate change adaptation strategies in several African countries and in India. Partners include numerous research groups, international organizations and universities.



Jeff Raikes, co-founder, Raikes Foundation

Intergovernmental Partnerships

Pat Mulroy, of the Brookings Institute, told the story of how one river community in the western U.S. — through carefully structured, deliberate intergovernmental partnerships — survived the worst drought cycle on record. Seven states overcame narrow self-interest to negotiate a water basin system that benefits everyone who relies on the Colorado River, a relatively small river system that provides water to some of the U.S.’s largest cities and most productive farmland.

The intergovernmental partnerships formed during times of surplus have become even more critical to survival, as climate change and population growth stresses the system.

The seven states initially entered into a compact granting each state equal rights to the river in 1922, which led to state and regional water storage systems. “The next 50 years were defined by each of the partners trying



Lake Mead near Hoover Dam, Nevada, USA

to get an edge on [its] partners,” Mulroy said, including a legal case that reached the U.S. Supreme Court. Meanwhile, states overused allotments as demand grew.

By the 1990s, the states recognized the need to overcome conflicts. After years of struggle, they eventually formed a new understanding and agreed to more cooperative guidelines. Soon after, a significant drought eliminated water surpluses in the system.

“We had to figure out how we’re going to deal with shortages,” Mulroy said. “Everyone had their little self-contained shortage plans, but none of them were strong enough or robust enough to be able to withstand the system’s collapse. The principles for which we laid a foundation in the ‘90s became all important.”

States began collaborating to benefit the basin as a whole, agreeing to impose restrictive water measurements before water levels became critical and allowing states to “bank” water in the system, incentivizing conservation measures. Remarkably, Mexico, which also has rights to Colorado River water, is also allowed to bank water in the U.S. system.

The storage measures helped alleviate the systems’ water storage levels enough to survive a severe drought in 2015. “As the system gets worse and worse, the states are now talking about what is our responsibility

to the system,” Mulroy said. “Partnership is not based on some greater good sense, but on self-preservation. At the end of the day, failure is not an option. And if failure’s not an option, the only path to success is through these kind of collaborative partnerships.”



Pat Mulroy, senior fellow, The Brookings Institute

IRRIGATING AFRICA



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Irrigating Africa

“Sub-Saharan Africa really is one of the poorest and most food insecure places in the world,” said KickStart International’s Martin Fisher. By 2050, the population is expected to double to 2.2 billion people, further straining resources. The vast majority of Africa’s poor — 80 percent — are smallholder farmers.

“It turns out that the best way for millions of these people, and especially smaller farmers, to escape poverty is to do a very simple thing: it’s to move from rainfed farming to irrigated agriculture,” Fisher said.

Developing smallholder irrigation in Africa received broad support. The opening workshop, “Opportunities and Challenges of Expanding Smallholder Irrigation in Sub-Saharan Africa,” in particular, explored irrigation’s potential to improve African food security and lift millions out of poverty.

Panelists discussed the underground resources available and benefits of tapping into it as well as the numerous challenges, both technical and institutional, of implementing irrigation. The workshop also engaged the audience with interactive small group discussions focused on developing a plan for moving forward.

Power to Transform

Jeff Raikes opened the workshop with a strong endorsement of irrigation’s benefits. “The potential to use irrigation and good water management as a transformative initiative for smallholder farmers in Africa is tremendous,” he said. He referenced his own family farm in Nebraska to illustrate irrigation’s potential. During the severe drought of 2012, his and other irrigated farms throughout the U.S. Corn Belt prospered because of irrigation.

Evidence is mounting that small-scale irrigation in developing regions substantially boosts incomes and increases overall rural prosperity, thereby bringing food security



Melissa D. Ho, managing director, Africa MCC

to millions of currently malnourished Africans. “I firmly believe . . . we are currently underestimating how critical water is to development,” said Melissa Ho, of the Millennium Challenge Corp., during her plenary presentation. “And as a result there’s a critical under-investment and [lack of] attention paid to the development of water itself.”

Several presenters noted the important, yet often overlooked, role irrigation played in the Green Revolution of the 1960s that help alleviate food security in India and elsewhere. Could irrigation bring a similarly transformative Green Revolution to Africa?

Fisher described a widowed Kenyan with a two-acre farm who, with the gift of a small irrigation pump from her father-in-law, earned enough money farming vegetables to acquire dairy cows and eventually a poultry farm. She now earns enough to send her children to urban private schools.

Introducing irrigation quadruples incomes by allowing smallholders to grow and sell high-value crops throughout the dry season when food is scarce and are prices high, Fisher said. Incorporating better seeds and fertilizer increases incomes tenfold. As the Kenyan farmer’s story illustrates, irrigation transforms subsistence rainfed farms trapped

“The potential to use irrigation and good water management as a transformative initiative for smallholder farmers in Africa is tremendous.”

—Jeff Raikes, co-founder, Raikes Foundation

in yearly feast-to-famine cycles into diverse, profitable businesses.

As climate change intensifies, irrigation also reduces vulnerability to weather extremes. As rains become less reliable, a stable water supply increases agricultural resilience. Less risk encourages farmers and lenders to invest in farm improvements, leading to further profits and greater food security nationally.

Investments in motorized pumps alone would benefit up to 185 million people in sub-Saharan Africa and generate over \$20 billion of net household revenue annually, according to results from the AgWater Solutions Project, said IWMI’s Meredith Giordano. The project is a multi-institutional organizational effort to understand smallholder farming’s limitations and to guide decision-makers.

The project also found that women and girls could benefit from irrigation through better education and less time spent collecting water, but an irrigation gender gap exists, said IFPRI’s Claudia Ringler. Irrigation favors male-dominated crops, and women lack access to financing and information. Without specific interventions directly supporting

women, irrigation does not improve women’s empowerment.

As farmers prosper through irrigation, so do communities. Businesses and jobs are created, transportation and financial infrastructures develop, health improves and more attention is paid to environmental conservation, panelists noted. With higher incomes comes increased power, leading to better land tenure and other rights. And at a national level, governments benefit by importing less food, exporting high-value crops during the dry season and collecting more taxes from a prosperous population.

Without irrigation, however, sub-Saharan Africa can’t become self-sufficient, said UNL’s Ken Cassman. As the population increases, the region will need about 86 million metric tons of maize by 2050 to be self-sufficient. The gap between actual yields and potential yields averages 80 percent in Africa, therefore huge yield increases are possible, he said, citing results from the Global Yield Gap and Water Productivity Atlas. But many regions, such as the Guinea Savanna, are harsh rainfed environments with questionable soil quality.

“Agriculture would never have developed much beyond cattle and ranching in western Nebraska, if it hadn’t been for irrigated agriculture precisely because it’s such a harsh rainfed environment,” Cassman said. “I don’t think you can expect to have the kind of [agricultural] development we need in sub-Saharan Africa without also thinking explicitly about where irrigation fits in.”

Despite the benefits, less than 5 percent of sub-Saharan Africa farmland is irrigated, compared to 20 percent globally. Of that small percentage, 40 percent are on large-scale farms and nearly all occur in just three countries: Sudan, South Africa and Madagascar. Irrigation has little impact on smallholder farming in Africa, Fisher said.

Yet sub-Saharan Africa has huge sustainable groundwater resources to substantially



Ken Cassman, emeritus professor, University of Nebraska–Lincoln



From left: Claudia Ringler, Roberto Lenton, Julie Wroblewski, Jeff Raikes, Martin Fisher and Meredith Giordano

increase irrigation. IWMI's Karen Villholth shared results of a study showing that, even under a conservative scenario, the present area of groundwater irrigation could increase by at least a factor of 15. The potential is especially significant in the semi-arid Sahal and East African corridor regions. Particularly encouraging, the study assessed only renewable groundwater resources and accounted for socio-economic factors, such as market availability and investment costs. Climate change, however, may affect groundwater recharge, and its impact is being investigated, Villholth said.

Risks and Challenges

Panelists acknowledged that enhancing smallholder irrigation carries risks, particularly to the environment. Key among them is depleting renewable and nonrenewable aquifers, a severe problem in parts of India following its Green Revolution. Small dams built for irrigation can also harm downstream water users, as is happening to upper Niger Delta fisheries in north-central Mali, said START's Jon Padgham, during the "Mitigating the Effects of Climate Change" session.

Ringler advocated a watershed approach that assesses all competing uses, including environmental flows, as well as creating

institutions for managing shortages.

Pasquale Steduto, of the FAO, also emphasized making the environment a priority from the outset. "I would strongly recommend to start with an assessment of what is the limits of exploitation of renewable water resources," he said. "If you don't start soon to set that and you push without heavy control of what's going on, there is a risk that we are repeating the history."

Other risks raised included conflicts over water rights, higher rates of waterborne diseases, soil salinization, migration propelled by water overexploitation or conflict, and potentially increased pressure to cultivate more land for agriculture.

In addition to avoiding risks, numerous challenges must be overcome. Presenters noted the high cost of irrigation technologies and lack of financing in rural areas; poor rural infrastructure, including roads, communication and electrification; and a lack of institutional coordination. Governments also tend to prefer large irrigation schemes to small-scale investments.

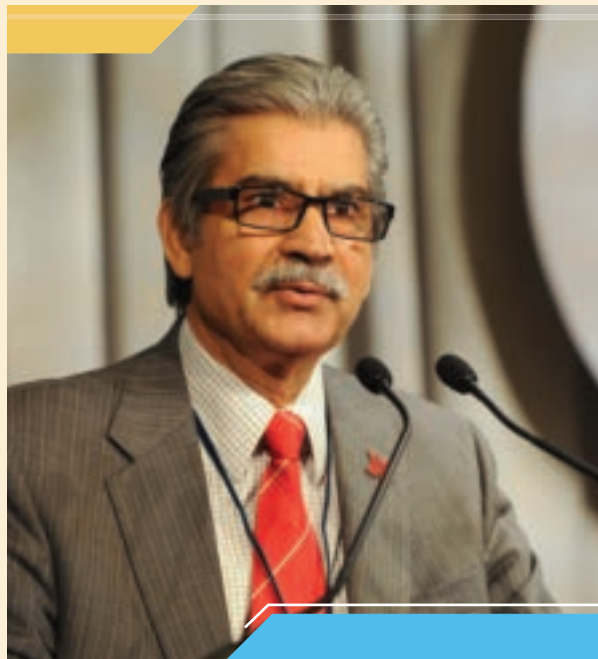
Social obstacles play a role as well. African smallholders are risk-averse, Fisher said. Unlike Asia, with its long tradition of irrigation, Africa has little experience with irrigation. Adopting irrigated agriculture would require a major behavior change.

In Memoriam: Prem Paul, UNL Vice Chancellor for Research and Economic Development, 1947–2016

Dr. Paul was instrumental in launching the Water for Food Global Institute, producing the very first Water for Food Global Conference in 2009, as well as the next three, and provided guidance to the institute until the university hired Roberto Lenton to serve as the institute's Founding Director in 2012. Paul continued to support the institute with enthusiasm and wise counsel until his passing on September 2, 2016.

Dr. Paul's remarks at the 2010 Water for Food Conference capture his belief in the institute:

“We are thrilled that the Robert B. Daugherty Charitable Foundation believed in our vision for the Water for Food Institute and has given us the initial resources to make it a reality. This is a megavision and realizing it will take the dedicated involvement not only of the University of Nebraska, but organizations everywhere who care about water for food and want to contribute. We have much to learn



from and to teach one another. And that is a basic principle of the Water for Food Institute: that it will be a distributed institute, based on partnerships and cooperative projects that bring together the best people, doing the best work, in the places where it is needed most.”

Solutions

“We talk a lot about Africa as a vulnerable place, but it's also a place with amazing resourcefulness and resilience, and I think sometimes we forget that in the narrative of vulnerabilities,” Padgham said. During the severe Sahel drought, for example, farmers returned to using Zai pits, a traditional, labor-intensive practice that helps conserve soil moisture.

Little data exists regarding the extent of small-scale irrigation in Africa, but Ringler said it is “thriving” and continues to grow, principally driven by individual farmers. “It

remains the preferred change adaptation strategy whenever we do household surveys. But most farmers feel that they are not ready or able to actually access the technology,” she said.

Progress is evident. Fisher described KickStart International's efforts designing and selling human-powered irrigation pumps to the poorest farmers in Africa. The non-profit, established in 2000, has sold over 275,000 pumps in 16 countries across sub-Saharan Africa, providing food security to more than 10 million. The non-profit iDE also employs irrigation pumps in Africa and Asia. Private companies from developed countries are also active, selling electric and petrol-powered pumps and drip

kits to slightly wealthier farmers.

“So there’s something happening, but we’re still a long, long way from where we need to be,” Fisher said.

The goal now is to overcome challenges and find a way to expand irrigation, said Peter McCornick, during his plenary presentation. “This can’t be done by providing philanthropic investment for each farmer. It has to actually be scaled up across the various communities and allow farmers to invest in their own areas. It’s actually looking at these as businesses.”

Scaling up will require major interventions from the public, private and social sectors. The conference raised many solutions, and the workshop, in particular, allowed attendees to participate in roundtable discussions designed to elicit ideas.

They included developing affordable irrigation technologies; educating farmers to encourage behavior change; linking irrigation with energy sector development to overcome a lack of electricity in rural Africa; monitoring groundwater levels and other environmental constraints; and developing strong policy support for irrigation.

Key to any solution that scales irrigation, however, is applying a market-based lens and involving the private sector, several presenters said. Profitable business models are needed to promote and sell the technology developed by the private sector, academia or NGOs, Fisher said. Financing mechanisms that reduce economic barriers, such as pay-as-you-go loan repayment or models for sharing high-cost technologies, must be included. It’s a value chain approach that spans all systems influencing smallholder farming, from inputs and soils to market and financing.

Establishing beneficial relationships among all stakeholders in the chain are critical, and presenters advocated the need for strong collaborations among a wide range of players, including local and national governments, NGOs, donor agencies, the private sector and rural farming communities.

The smallholder farmer is the most important private-sector player, said Ho, during the workshop. They are customers,

not just beneficiaries, and must be included in conversations to understand customer needs. Ultimately, smallholder farmers are driven by profitability, several presenters emphasized. Farmers will adopt irrigation and invest in irrigation when they see a clear benefit.

“In the end, it’s the profitability for the smallholder that is going to be the driving force behind all of this,” said Roberto Lenton, WFI founding executive director.

Above all, sub-Saharan Africa needs an irrigation champion and a platform to coordinate efforts, participants urged. Irrigation falls between the water and agricultural ministries and, unlike seeds and fertilizer, no private company or donor has lobbied for it, in part because irrigation is perceived as damaging the environment. A champion could collaborate across sectors, aid communication and data sharing among different stakeholders, promote needed research and coordinate investments.



Treadle irrigation pump

TECHNOLOGY



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Technology

New technology and innovations have and will continue to play an outsized role in solving the water for food challenge. Throughout the conference, participants shared advances, from agri-corporation Syngenta's varietal improvements in corn to data analytics company FarmLink's on-farm support. Panel sessions dedicated discussions to technological and innovative progress in a number of agricultural and water areas. Even as technology develops, farmers aren't eager to adopt many of the innovations, and several sessions addressed overcoming the adoption challenge.

Technology on Display

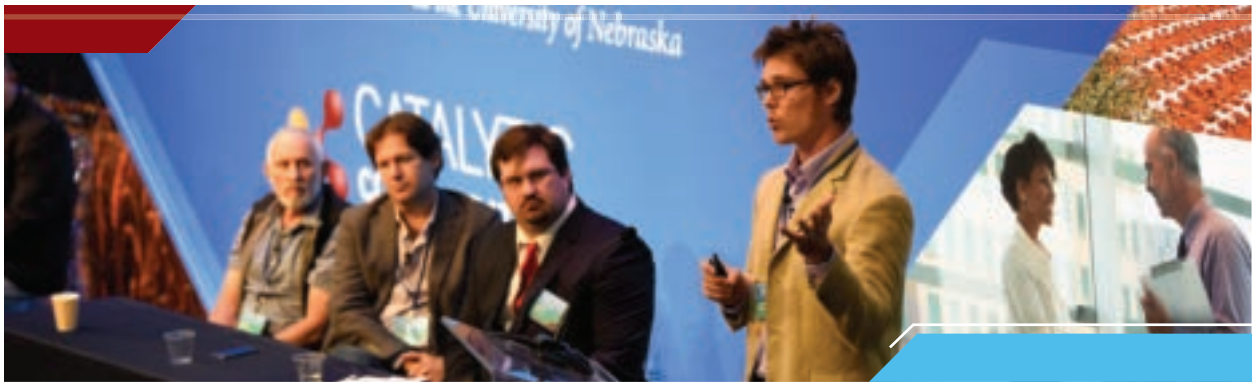
- **Water and Food Processing:** Reconditioning water used in food manufacturing is an opportunity to reduce food production's water footprint. In this panel, Christopher Simmons, of the University of California, Davis, offered a case study on water and energy use in industrial tomato processing. USDA-Agricultural Research Service's Rebecca Milczarek described opportunities to use wastewater generated in food manufacturing and detailed olive oil and bean processing as examples. Greg Thoma, of the University of Arkansas, discussed the uses and limitations of lifecycle analysis as a tool for improving water conservation in food processing. UNL's Bing Wang discussed how risk assessment can — and should — be used to inform sound risk management options in the food industry. And UNL's Yulie Meneses Gonzalez followed with a detailed case study of using risk assessment for water conservation in dairy production.
- **Information Technology:** Panelists discussed how to use information technology to collect, analyze and produce stakeholder value-added products to improve agricultural livelihoods. Kelly Caylor, of Princeton University, described new instruments he's developing to "leap-frog" conventional methods of data gathering by leveraging new technology, from smartphones and cheap sensors to open computing ecosystems. Colin Everson, of the University of KwaZulu-Natal in South Africa, discussed his experiences working on sustainable water, food and energy management in rural South Africa. Jay Angerer, of Texas A&M University, described an early warning system he's developing to help livestock producers manage risk. Luke MacDonald, of Johns Hopkins University, described PMA2020, a project at the Johns Hopkins Water Institute that uses cellphones and local training to quickly obtain population-based estimates and other information. And Ammar Wahbi, of the Joint FAO-International Atomic Energy Agency Program in Austria, described how the program coordinates collaborations between developed and developing countries on sustainable use of agricultural resources within the context of climate change.
- **Agricultural Technology:** Panelists discussed emerging technologies in agriculture, particularly related to the efficient use of water and food production. UNL's Daniel Schachtman discussed a multi-institutional project he



Christopher Simmons and Rebecca Milczarek



Yulie Meneses Gonzalez



From left: Colin Everson, Kelly Caylor, Trenton Franz and Luke H. MacDonald in the Technology session



From left: Archie Clutter, Daniel Schachtman, Arthur Zygielbaum Michael Dowgert (standing) and Scott Shearer in the Agricultural Technology session

leads that uses a systems approach to enhance sustainable biofuel feedstock production. UNL's Arthur Zygielbaum highlighted several remote-sensing technologies that provide biophysical estimations. Michael Dowgert, of analytics company CropX, described how to commercialize products and the importance of making products user friendly. Scott Shearer, of Ohio State University, described a variety of evolving technologies and the opportunities universities have to move into the pre-production arena.

- Agricultural Entrepreneurship:** This session provided participants with an opportunity to engage with entrepreneurs in small group discussions. Featured entrepreneurs represented small early stage startups as well as more established companies. Their innovative products and processes covered a range of applications, including smart sensors, crop advisory and irrigation management services, financing and water market systems. Richael Young, of Mammoth Trading and WFI, described the challenges of working with

stakeholders to develop “smart” markets for water rights. Adam Wolf, of Arable, explained the high-tech capabilities of his company's Pulsepod device. Student entrepreneur Brennan Costello outlined his experience building FarmAField, an online marketplace for cattle. Kian Alibakhshian, of Smart Water Metering, highlighted the process of developing a technology that helps optimize water and energy use in agricultural irrigation. Barclay Rogers, of Good Earth Irrigation, commented on the value of his business model with respect to absentee-owned farmland. And Randy Barker, of FarmLink, described his efforts to identify new opportunities for business development.

- Irrigation Technology for Smallholders:** In addition to addressing small-scale irrigation, panelists addressed the importance of governance structure and farmer organizations. Moderator Timothy Prewitt, of non-profit iDE, commented on yield gains with smallholder irrigation and the challenges of improving food markets. His iDE colleague,



Timothy Prewitt, iDE (left) and Christopher Neale, WFI



Richael Young, Mammoth Trading; WFI



Adam Wolf, Arable



Brennan Costello, Farm Afield

Stuart Taylor, expanded on trends and opportunities for smallholder farmers from iDE’s experiences, including creating a market for treadle pumps. Gary Merkeley, of Natural Resources Consulting Engineers, addressed irrigation water management and detailed his experiences creating water user associations. And José Luis Arumí, of the Universidad de Concepción in Chile, followed with a case study describing irrigation management in Chile, particularly the country’s experiences with water user organizations.

Big Data

Advancing technology is creating vast amounts of data cheaper, easier and faster than ever. Presenters described the benefits — and promise — of this expanding big data. But many also acknowledged the challenge of corralling data to use effectively.

Technologies are coming together to allow producers to manage data and their farms in ways never before possible, said Owen Palm, of 21st Century Equipment, during the “View

from the Field” panel. His fellow panelists agreed, describing the importance of soil moisture metering to make better irrigation decisions and monitoring wells to improve conservation efforts.

The panel Big Data: “Partnerships to Leverage Data for Water and Food Security” discussed how data is addressing farm-level issues, but it focused on macro-level benefits as well. Lee Addams described how his startup company, Good Earth Irrigation, uses data to assess fields with high potential value for introducing irrigation. Investing in those analytics is beyond the scope of individual landowners, but important for his company to scout opportunities, he said.

Enlarging farm-level data to include tens of millions of acres in real time requires turning agronomic insights into machine learning algorithms, statistics and data pipelines, said fellow panelist John Gates, of Climate Corporation. “I feel like that’s where one of the main opportunities lies right now: doing this at scale in an accurate way that’s timely for growers,” Gates said.

“As I see it, and as we’ve quantified, we’re not on track to feed 9 billion people on existing land without destroying the planet.”

—Ken Cassman, emeritus professor, University of Nebraska–Lincoln; WFI Faculty Fellow

UNL’s Ken Cassman agreed and raised the urgency of harnessing data to a global level. “As I see it, and as we’ve quantified, we’re not on track to feed 9 billion people on existing land without destroying the planet,” he said. Although innovation has been remarkable to date, the rate of yield gain is too slow, resulting in rising food prices and new land used for agriculture.

He advocated ensuring every farmer has access to a database containing information about best practices specific to each farmer’s agricultural conditions. Publicly available information would help farmers — big and

small — make tactical management decisions. Tools, such as the Global Yield Gap and Water Productivity Atlas Cassman described during the smallholder irrigation workshop, could help provide such information.

“If every farmer had access to knowing, for all cohort fields with the same properties, what the top 5 percent of farmers farming the same soil and climate type did, the rate of innovation would accelerate, I think, tremendously,” he said. The private sector would still make huge profits by stepping in to help farmers further improve management.

Public databases also could be used to benchmark agricultural progress, efficiency and other environmental factors, he added. Because agriculture has a tremendous impact on water and soil quality, biodiversity habitat and climate change, it’s in the public interest to regulate it. Regulation would improve public support.

Adopting Technology

Many tools to help farmers already exist. The biggest challenge is low adoption rates, Palm said, during the “View from the Field” panel. Eighty percent of producers don’t use the available technology.

Private companies are springing up to help farmers make sense of new on-farm data, but more support is needed because farmers still find the data too complex to use, said Anil Jain, of Jain Irrigation, during the “Industry Panel.” Companies are spending millions of dollars on accumulating data, but farmers aren’t ready to accept it. “We need to make a concerted effort to break that barrier, so that big data can be really helpful to the people who are supposed to use it,” he said.

Breaking the barrier requires trust and partnerships beyond the traditional support of equipment and seed suppliers, said Nebraska farmer Roric Paulman, during the “View from the Field” panel. “It’s very difficult to put [data] into perspective and turn it into a decision-



From left: Owen Palm, John Berge and Roric Paulman



Ken Cassman (left) accepts an award recognizing his contributions to water and food security from Prem Paul and Ronnie Green.

Ken Cassman Award Recognition

The farm-to-table dinner provided an opportunity for the Water for Food Global Institute to recognize Ken Cassman, Water for Food Global Institute Faculty Fellow and Emeritus Robert B. Daugherty Professor of Agronomy at the University of Nebraska–Lincoln, for his significant contributions to improving global water and food security. Cassman’s award was presented by UNL Vice Chancellor for Research and Economic Development Prem Paul and UNL Chancellor Ronnie Green.

Working at the intersection of agriculture and environmental advocacy, Cassman worked tirelessly during his career to improve yields, profit and environmental performance of crop production systems around the world. His work focused on soil fertility and nutrient management, food security and yield gap analysis at local to global spatial scales. During the past six years, Cassman co-led the Global Yield Gap and Water Productivity Atlas, an interactive, map-based web platform that estimates exploitable gaps in yield and water productivity for major food crops worldwide (yieldgap.org). The project helps farmers, governments, policymakers, foundations, private sector organizations and others identify regions with the greatest potential to sustainably produce more food. He also chaired the CGIAR Consortium’s Independent Science and Partnership Council. Previous roles include head of UNL’s Department of Agronomy and Horticulture, head of the Agronomy, Plant Physiology and Agroecology Division at the International Rice Research Institute in the Philippines, faculty member at the University of California, Davis, and research agronomist in Brazil and Egypt.

making tool and trust all of the people that are suggesting that you can either pay them or be a part of this business model to help you out.”

John Berge, of the North Platte NRD, suggested incentivizing farmers. Altering land practices may be good for the environment, but convincing farmers requires proving it improves yields and bottom lines. “Changing behavior on the land is something that we can do as short-term investments and have a much more long-term impact,” he said.

The “Big Data” panel also addressed technology adoption. Only 10 percent of U.S. farmers irrigate using soil moisture meters,

Addams said. Either they don’t yet understand the benefit or it’s too expensive, and he called on the private sector to drive adoption. Gates added that the agricultural community could better address reasons for skeptical non-adopters. One of those limiting factors is hard-to-use products. “Start by making things dead easy and see how it goes,” Gates advised.

Fellow panelist Cassman said benchmarking also would help farmers compare their performance and incentivize change, particularly with absentee landlords. But in the end, he said, “people who don’t farm well are going to have to go out of business.”

GOVERNANCE AND THE MARKET



Water for Food
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GOVERNANCE AND THE MARKET

Science has contributed extraordinary technological innovations that have played critical roles in improving water and food insecurity. Equally important are aligning governmental policies and societal influences with water conservation and agricultural goals.

Informing policy is one of the science community's most important roles, but connecting the right science with the appropriate policy is complex, said FFAR's Sally Rockey, during her plenary presentation. "I just would plead that we all try to think about whatever capacity — whether economic research, social science research, agriculture research in plant breeding or other areas — that we use that as evidence base for policy development."

The conference highlighted several areas where research and societal forces intersect, including climate change, sustainability and market development.

Climate Change

Climate change and its effects must be addressed or water and food security solutions will fail, said Lewis Ziska, of the U.S. Department of Agriculture, during the "Mitigating the Effects of Climate Change" session.

He described several threats, such as snowpack loss, which reduces water available for irrigation and other uses. "Many of the world's primary rivers, the source of surface irrigation, are drying up," he said, including the U.S.'s Colorado River, Indus River in South Asia, and Australia's Murray Darling River.

Pests represent another threat. Kudzu, an aggressive invasive vine that carries Asian soybean rust, is migrating north in the U.S. Midwestern region due to warming winters. Other pests are also migrating. "It's going to be changing rapidly. I don't think we appreciate the nature of that change," Ziska said.



Drought in Brazil

He agreed with an audience member who suggested new genetic varieties and other measures increase farmers' resilience. But resilience and adaptability may have a limit, he warned. Climate change is shifting the Corn Belt northward and altering pest biology.

The USDA is investigating adaptation strategies, such as switching to more robust crops like sorghum, and Ziska advocated for additional monitoring of threats. Despite the need for developing strategies, however, budgets for climate change research continue to be cut, he said, citing the decade long trend at USDA.

The developing world also faces increased vulnerability from climate change, said fellow panelist Jon Padgham, of START. Many complex environmental, political and social realities intermix, challenging efforts to adapt. He cited resource degradation; increasing pressure to sell firewood for income, which further harms the environment; land ownership instability, which discourages investments in technologies and new practices; and smallholder farmers with fewer opportunities, less education and less access to services. When finding adaptation strategies, it's important to understand how these "multidimensional vulnerabilities" relate, he said.

Social issues add layers of difficulty. For example, South African maize production



From left: Lewis H. Ziska, Jon Padgham and Elizabeth VanWormer in the climate change/public health session

is one of the most vulnerable agricultural zones. Switching to sorghum, a better fit in a warming climate, is complicated by the “social lock” on maize, from processing to consumption. “So it’s not just changes in the field, but there are all of these other very difficult systemic changes that have to take place with the milling processing and social attitudes. So that’s a real challenge in those environments,” Padgham said.

In West Africa, several countries are attempting to transfer authority to district and local levels, efforts that currently exist only on paper, he continued. The ongoing authority vacuum exacerbates conflict between farmers and herders. And many top-down policies leave local communities out of decision-making, particularly in managing protected areas and adaptation planning. Policies are developed, but information, resources and capacity don’t reach local levels to implement the work.

Climate change also influences interactions between human health, food production and the environment, particularly as it pressures food and water security, said UNL’s Elizabeth VanWormer. She enumerated numerous ways in which food production and water scarcity affects human health. For example, as food demand increases, agricultural land extends further into wild areas, increasing wildlife contact and the flow of pathogens. Zoonotic diseases also demonstrate the link between wildlife and domestic animal production, whether pigs on a smallholder farm in Africa or a Nebraska feedlot.

She detailed a study of livestock keepers in Tanzania she participated in where people, livestock and wildlife interacted. The interactions included bathing in the local river where both livestock and wildlife congregate and sharing household space with chickens and pigs. In addition to sharing pathogens, contamination, such as agricultural pesticides, run off into the river, where they aggregate and expose numerous populations downstream.

Ill health — from malnutrition and diseases to mental health stress — leads to additional economic pressures, which influences food and water security. “So not only do we manage disease in our backyards, we also manage disease on a much broader scale with how we shape our ecosystems, how we use our landscapes, how we manage our animals, and the choices we make in building our cities and towns and other environments,” VanWormer said.

Sustainability Lessons from Nebraska

Many countries, including the U.S., have long been extracting groundwater at unsustainable levels, which contributes to salinization and other environmental problems, said WFI’s incoming Executive Director Peter McCornick, during his plenary presentation.

Nebraska is an exception. The state’s irrigated agriculture is a sustainability success story, he said. Over the past 30 years, its irrigation has tripled in area, but

World Premiere of “Thirsty Land”

The first day of the 2016 Water for Food Global Conference included the world premiere of “Thirsty Land,” a feature-length documentary sponsored in part by the Water for Food Global Institute and the Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln. The film tells the story of extreme drought, agriculture and the water crisis in the western U.S. and how these challenges impact farmers, local communities and the environment. Director Conrad Weaver interviewed farmers, ranchers and researchers from central Nebraska to the Central Valley of California to learn how they are managing their water resources to continue to produce food for our world. Following the reception and film screening, participants engaged in a question-and-answer session with Weaver.

Visit thirstylandmovie.com to learn more.



Nebraska’s portion of the High Plains Aquifer has remained stable. The success is due in part to technological advances, improved practices and well-managed governance.

Transferring the success elsewhere wouldn’t be easy, McCornick said. Machinery size, access to technology and institutions around groundwater governance may differ, but Nebraska’s success contains important governance lessons for others.

Establishing locally run Natural Resources Districts to manage groundwater resources at watershed levels played a large role in the state’s success, McCornick said. Some NRDs require water meters on all irrigation wells. In the View from the Field session, Nebraska farmer Roric Paulman said metering required years ago on part of his large farm was an eye opener that changed his behavior. “It put us in the mindset of how do you do on-farm conservation and be the best stewards of the resources,” he said.



Drip irrigation

“I believe that we can make the world a better place to be by putting a price on water. I don’t think there is any better place to start than here in Nebraska, the Ogallala [Aquifer].”

—Richard Sandor, chairman and CEO, Environmental Financial Products

Technology, such as variable rate irrigation and soil moisture monitoring, help him conserve water, benefiting the aquifer and his bottom line.

To meet its regulatory goals, the North Platte NRD instituted several programs, including a moratorium on acreage expansion and well drilling, said the district’s John Berge. It also pays farmers to take marginal land out of production and to relinquish some water allocations.

The civility displayed between regulator and farmer is representative of water policy interactions today, but not necessarily of the past, said Valmont Irrigation’s Bob Meaney, during the closing panel. Nebraskans resolved many aquifer problems by taking it to the local level, protecting the economy and talking through issues.

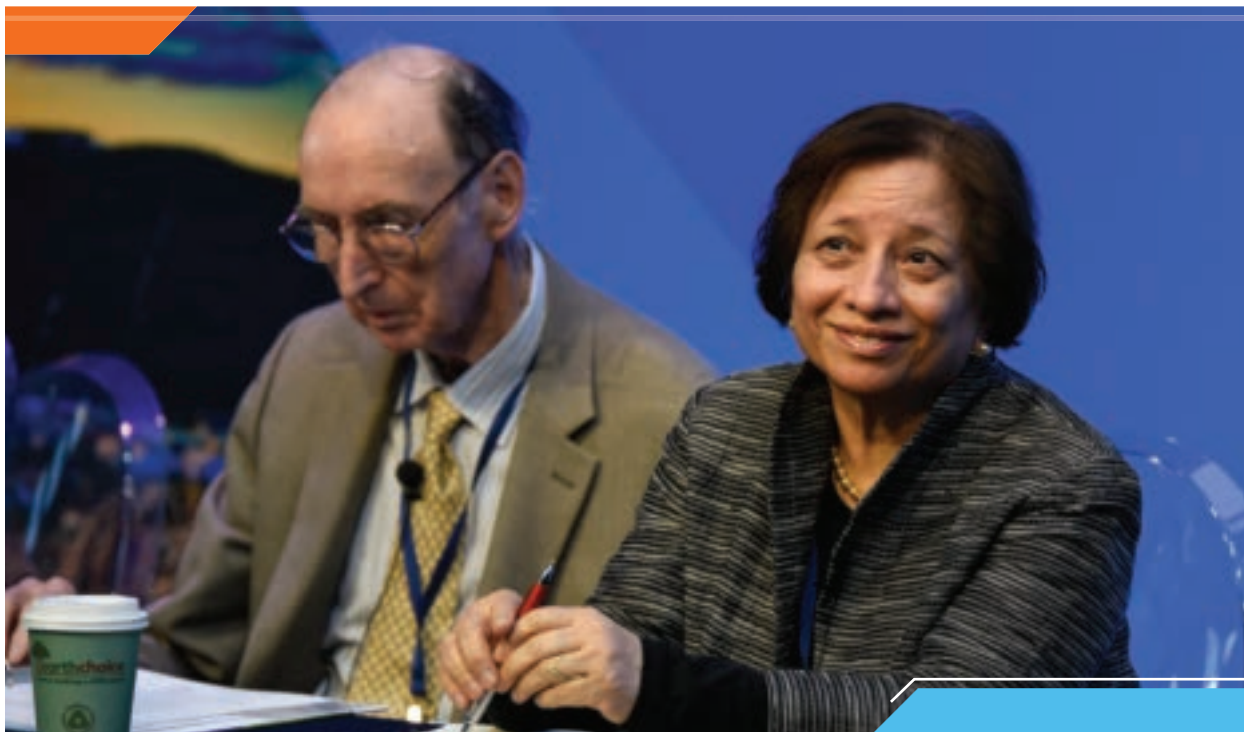
Fellow panelist Uma Lele, a development economist, advocated examining the

experiences of places like Nebraska and their implications for policy reform elsewhere. Increasing water use efficiency is so complex that policymakers aren’t giving enough consideration to data requirements at the watershed level, she said. “We just need to know so much more in terms of data that are relevant for policymaking at different levels. And I’m not sure yet we have that in developing countries to a level that one sees in a place like Nebraska.”

She also questioned whether many countries’ policymakers have the political will, institutional sophistication or willingness to charge farmers what’s necessary to manage water.

Market Forces and Value Chains

Understanding agricultural market forces and creating value chains are critical components



Peter Rogers and Uma Lele, WFI International Advisory Panel members



Richard Sandor, chairman and CEO, Environmental Financial Products

to improving food security, panelists noted. At a global level, food chains are becoming increasingly integrated so decisions made in the U.S. and Australia have implications for food prices in Africa and elsewhere, Padgham said. These and other global drivers, such as increasing urbanization, can increase food insecurity and political instability, leading to crises.

On a local level, a farmer with 1 hectare of land, even with irrigation, will likely remain poor without a food chain supply system that allows the farmer to commercialize, said Harvard University's Peter Rogers, during the closing panel.

Anil Jain, of Jain Irrigation agreed and offered a successful example of creating an agricultural supply chain for smallholder farmers that provides a stable income and allows farmers to invest in irrigation and other farm improvements.

Speaking during the "Industry Panel," Jain described how Jain Irrigation Systems expanded its business beyond supplying drip irrigation to purchasing produce from farmers with price assurances. The company offers farmers a floor price for their produce, a guaranteed income regardless of market prices. If market prices substantially exceed the floor price, however, Jain pays 10 percent over market. Following this innovative solution, the farmer is making additional income and the company receives high quality produce.

Jain admitted the company initially lost money due to low quality produce. So it

worked with farmers to improve agricultural practices and inputs. The company also had to develop good manufacturing practices. "Farmers are now competing with each other to try and be our suppliers," Jain said. "And that helps us to get a good quality supply and then become a good reliable food supplier to the big global food companies."

The Case for Water Markets

Water will be the commodity of the 21st century, driven by world population growth and uneven water distribution and consumption, said Richard Sandor, of Environmental Financial Products. "We are at a point now where water is no longer what economists call a free good. And when we have market failures — that is, public goods in which there are no property rights — we have to look at different tools."

The Americas and Europe are far richer in water than North Africa, the Middle East, India and China, and this water imbalance is reflected in water markets, he said. "But we don't call them water markets. We call them grain markets, and grain is just simply a surrogate for the international importation and exports of water. ... So in effect we trade water; we just do it inefficiently."

He cited increasing global conflicts over water, and by implication food prices, to help make the case for establishing water markets.

To incentivize conservation, he advocated pricing water use above a base amount and allowing people to monetize the gains from using less water. Numerous challenges must be overcome, including creating water property rights, monitoring use and building consensus. But Sandor cited examples demonstrating behavior change driven by environment markets, including water use in Australia's Murray Darling Basin and quota shares in New Zealand fisheries.

"I believe that we can make the world a better place to be by putting a price on water," Sandor said. "I don't think there is any better place to start than here in Nebraska, the Ogallala [Aquifer]."

CONCLUSION



Water for Food
GLOBAL CONFERENCE
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Conclusion

The water for food challenge won't be solved alone. It's too complex, too entrenched, with too many interconnected pieces. It requires partnerships among many disparate groups. While that may seem obvious, partnerships involving farmers and policymakers, NGOs, academia and corporations are difficult to accomplish and, as an audience member noted, time consuming. Collaborations aren't pursued as vigorously as they must be, if we are to meet future global food demand while using less water resources.

Despite the difficulty of merging differing objectives and operating styles, successful partnerships are thriving worldwide and accomplishing more by working together. These successes offer examples for others and underscore the benefits to each participant, from sharing resources to broadening opportunities. At WFI, we work toward accomplishing our water for food mission through creating and participating in partnerships among public and private entities globally.

We chose to emphasize the catalytic power of public-private partnerships at the 2016 Water for Food Global Conference to improve effective water management and agricultural productivity. At this, as at previous conferences, presenters and attendees represented a diversity of experts working at all scales and sectors in the water for food arena, a supportive setting for sharing ideas and encouraging unique partnerships.

The conference paid particular attention to the opportunities of partnerships to transform sub-Saharan Africa through small-scale irrigation. "I've always been struck by the paradox of sub-Saharan Africa where



Roberto Lenton, founding executive director, WFI

you have relatively abundant water resources and yet the lowest proportion of irrigated agriculture," said WFI Founding Executive Director Roberto Lenton. "So here we have a situation where the water in large part is there, but the irrigation that could really transform the lives and livelihoods of millions and millions of smallholder farmers in sub-Saharan Africa is simply not there."

To advance irrigation development in Africa, participants learned about the successes occurring at the confluence of technological advances, policy measures, behavior change

"We have a situation where the water in large part is there, but the irrigation that could really transform the lives and livelihoods of millions and millions of smallholder farmers in sub-Saharan Africa is simply not there."

—Roberto Lenton, founding executive director, WFI



Laying irrigation lines in Ein Harod

and other societal adaptations in Africa and elsewhere. Many challenges remain, but presenters and attendees raised numerous solutions and steps forward.

The need to create markets — a theme that arose during the conference — also became evident. Markets play a role in both putting new practices and tools into place, such as irrigation, and moving produce from the farmer's field to consumers.

The themes of public-private partnerships, smallholder irrigation, and markets were perhaps best illustrated by Jain Irrigation's transformation from a drip irrigation supply company in India to a diverse multinational corporation, in what Margaret Catley-Carlson, of Canadian Water Network, characterized as a “silver bullet.”

As Jain's story illustrates (page 39), public-private partnerships can achieve long-term

sustainable impact. The 2016 Water for Food Global Conference highlighted how partnerships, technological advances and institutional factors, together, are able to make significant strides. Jeff Raikes, of the Raikes Foundation, challenged attendees to look at their individual interventions and consider how partnering with others could catalyze those efforts into something more significant, long-term and sustainable.



Full presentations from the conference are available on our YouTube channel at youtube.com/WaterForFood.

Section: Appendix

Workshops, Events and Presentations

Sunday, April 24, 2016

WORKSHOP

The Opportunities and Challenges of Expanding Smallholder Irrigation in sub-Saharan Africa

Co-convened by the Bill & Melinda Gates Foundation, KickStart International and the Water for Food Global Institute; in partnership with CGIAR Research Program in Water, Land and Ecosystems

Despite the relative abundance of water in sub-Saharan Africa, only a fraction of agricultural land in the region is irrigated. Smallholder farmers could dramatically improve their agricultural production by using small-scale technologies to irrigate from shallow groundwater. Smallholder farmers in this region are starting to irrigate, but to move Africa toward full food security, millions more need to join them. We must better understand the constraints that are holding back irrigation development, and create and implement a set of public and private approaches to overcome these obstacles. This collaborative workshop served as a springboard for a new campaign supporting expanded irrigation in sub-Saharan Africa. Participants worked to define the challenges facing smallholder farmers from technical, economic, social and environmental perspectives and developed a preliminary framework for solutions.

Presenters

Kenneth Cassman, Emeritus Robert B. Daugherty Professor of Agronomy, University of Nebraska–Lincoln, Faculty Fellow, Water for Food Global Institute; Lincoln, Nebraska

Martin Fisher, Co-founder and CEO, KickStart International; Nairobi, Kenya

Meredith Giordano, Adviser, Research Strategy and Management, International Water Management Institute; Washington, D.C.

Melissa D. Ho, Managing Director, Africa, Millennium Challenge Corporation; Washington, D.C.

Roberto Lenton, Founding Executive Director, Water for Food Institute; Lincoln, Nebraska

Claudia Ringler, Deputy Division Director, International Food Policy Research Institute; Washington, D.C.

Jeff Raikes, Co-founder, Raikes Foundation; Board Chair, Water for Food Institute; Seattle, Washington

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

Karen G. Villholth, Principal Researcher, Groundwater Management, International Water Management Institute; Pretoria, South Africa

Julie Wroblewski, Strategy Advisor and Consultant, Bill & Melinda Gates Foundation and Pivotal Ventures; Los Angeles, California

WORLD PREMIERE OF “THIRSTY LAND”

The conference featured a reception and film screening of “**Thirsty Land**,” a new documentary sponsored by the Water for Food Global Institute and the Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln. “Thirsty Land” tells the story of extreme drought, agriculture and the water crisis in the western United States and how these challenges impact farmers, local communities and the environment. Following the film, participants engaged in a question-and-answer session with Director Conrad Weaver, President, ConjoStudios, LLC; Emmitsburg, Maryland.

Monday, April 25, 2016

PLENARY SESSION I

Welcome

Hank M. Bounds, President, University of Nebraska; Lincoln, Nebraska

Catalytic Philanthropy

Jeff Raikes, Co-founder, Raikes Foundation; Board Chair, Water for Food Institute; Seattle, Washington

Introduction of the new Water for Food Institute Executive Director-elect

Roberto Lenton, Founding Executive Director, Water for Food Institute; Lincoln, Nebraska

The Future of Water and Food Security

Peter McCornick, Deputy Director General of Research, International Water Management Institute; Executive Director-elect, Water for Food Institute; Colombo, Sri Lanka

Special presentation by Board Chair Jeff Raikes

Water for Food Institute Board of Directors and Leadership

- Formal dedication of the **B.H. Jain/** University of Nebraska Water for Food Collaborative Program
- Award bestowed to **Anil B. Jain**, Managing Director, Jain Irrigation Systems, Ltd; Jalgaon, India, in memoriam of Bhavarlal Hiralal Jain, Founder Chairman of Jain Irrigation and “Champion of Agricultural Water Management.”

PLENARY SESSION II

Perspectives on Partnerships in Water Management

Pat Mulroy, Senior Fellow, Climate Adaptation and Environmental Policy, Brookings Institute; Practitioner in Residence, Saltman Center for Conflict Resolution, William S. Boyd School of Law, University of Nevada Las Vegas; Maki Distinguished Faculty Associate, Desert Research Institute; Las Vegas, Nevada

Challenges and Opportunities in Achieving Food Security in Africa

Melissa D. Ho, Managing Director, Africa, Department of Compact Operations, Millennium Challenge Corporation; Washington, D.C.

LUNCHEON KEYNOTE ADDRESS

Advancing Productivity for Smallholder Farmers in sub-Saharan Africa through Irrigation

Martin Fisher, Co-founder and CEO, KickStart International; Nairobi, Kenya

INDUSTRY PANEL

Those who work in the business of agricultural production will discuss their perspectives on the role of private industry in partnering with producers, agencies and non-profits to increase water and food security. The panel will provide an interesting opportunity for a wide ranging discussion of public-private partnerships at different points along the “farm to table” spectrum.

Moderator:

Ronnie D. Green, Chancellor-elect, University of Nebraska–Lincoln

Panelists:

Randy Barker, Managing Director, FarmLink; Kansas City, Missouri

Anil B. Jain, Managing Director, Jain Irrigation Systems Ltd.; Jalgaon, India

E. Robert Meaney, former Chairman International, Valmont Industries, Inc.; Riverside, Connecticut

Chris Tingle, Head, Enogen Commercial Operations, Syngenta, Minnetonka, Minnesota

Michael W. Willer, Vice President, Research and Development, North America, Ecolab; St. Paul, Minnesota

SESSION I: IRRIGATION TECHNOLOGY FOR SMALLHOLDERS

This session covered different aspects of irrigation for smallholders with examples of how technologies, such as small pumps, drip and sprinkler irrigation systems implemented at different scales and others, are being used to benefit smallholder farmers. Examples of projects being developed were discussed, including public-private efforts. The importance of governance structure and farmer organizations was also highlighted.

Moderator:

Christopher Neale, Director of Research, Water for Food Institute; Lincoln, Nebraska

Opening Remarks:

Timothy Prewitt, CEO, iDE; Denver, Colorado

Speakers:

José Luis Arumí, Director, Water Resources Department, Faculty of Agricultural Engineering, CRHIAM Water Center, Universidad de Concepción; Chile

Gary P. Merkley, Water for Food Global Institute Global Fellow; Irrigation and Hydraulic Engineer, Senior Supervising Engineer, Natural Resources Consulting Engineers, Inc.; Fort Collins, Colorado

Stuart Taylor, Vice President, Global Initiatives, iDE; Winnipeg, Canada

SESSION II: WATER AND FOOD PROCESSING

Water reconditioning and reuse represent a potential opportunity to reduce the water footprint from food products through conservation initiatives. However, several concerns related to investment, contamination risks and additional environmental impacts (energy) impose constraints to move forward. Stakeholders from academia, government agencies and the private sector discussed how to face these challenges and understand the opportunities and limitations for food processors. This session helped assess water conservation initiatives from a holistic approach, with the goal to contribute to the successful implementation of such initiatives in

the food industry sector.

Moderator:

Rolando A. Flores, Water for Food Global Institute Faculty Fellow; Professor and Department Head, Department of Food Science and Technology; Director of the Food Processing Center, University of Nebraska–Lincoln

Panelists:

Yulie Meneses Gonzalez, PhD Candidate and Research Assistant, Department of Food Science and Technology, University of Nebraska–Lincoln

Rebecca Milczarek, Research Agricultural Engineer, U.S. Department of Agriculture – Agricultural Research Service; Albany, California

Christopher Simmons, Assistant Professor, Department of Food Science and Technology, University of California, Davis

Greg Thoma, Bates Teaching Professor of Chemical Engineering, University of Arkansas; Fayetteville, Arkansas

Bing Wang, Assistant Professor, Department of Food Science and Technology, University of Nebraska–Lincoln

SESSION III: MITIGATING THE EFFECTS OF CLIMATE CHANGE ON WATER AND FOOD SECURITY AND PUBLIC HEALTH

The connections between climate change, water budgeting and the agricultural environment have significant effects on public health of the surrounding communities. It is vitally important to build adaptive capacity in the agricultural sector to ensure food security, while also safe-guarding water quality and quantity. Dealing with the environmental impacts of climate change requires adaptation and thoughtful crop selection to maintain sufficient availability of food, while also minimizing water use. Additionally, it is important to examine the effects of climate change on agronomic pests and invasive

species in both managed and unmanaged plant communities, and the interactions between animals and humans. Developing public-private partnerships to address these complex issues is a key element to mitigating the effects of climate change by identifying opportunities to build capacity and implement solutions, locally to globally.

Moderator:

Ken Haar, Nebraska State Senator; Malcolm, Nebraska

Panelists:

Jon Padgham, Deputy Director, START; Washington, D.C.

Elizabeth VanWormer, Water for Food Global Institute Faculty Fellow; Epidemiologist and Assistant Professor of Practice, School of Veterinary Medicine and Biomedical Sciences and the School of Natural Resources, University of Nebraska–Lincoln

Lewis H. Ziska, Plant Physiologist, U.S. Department of Agriculture – Agricultural Research Service; Beltsville, Maryland

RECEPTION AND FARM-TO-TABLE GALA DINNER AND FACULTY RECOGNITION

Participants attended a reception with live music by The Bottletops, followed by a special farm-to-table dinner featuring all locally-sourced foods. The dinner provided an opportunity to recognize Water for Food Global Institute Faculty Fellow Kenneth Cassman, Emeritus Robert B. Daugherty Professor of Agronomy at the University of Nebraska–Lincoln, for his significant contributions to improving global water and food security. The award was presented by UNL Chancellor-elect Ronnie D. Green.

Tuesday, April 26, 2016

VIEW FROM THE FIELD PANEL

Nebraskans involved in the production channel shared their experiences and expectations for the future of improving agricultural

production and water security.

Moderator:

John T. Heaston, Private Consultant; Lincoln, Nebraska

Panelists:

John Berge, General Manager, North Platte Natural Resources District; North Platte, Nebraska

Owen Palm, CEO, 21st Century Equipment, LLC; Scottsbluff, Nebraska

Roric Paulman, Owner and Operator, Paulman Farms; Sutherland, Nebraska

PLENARY SESSION III

Carbon Credits and Water

Richard L. Sandor, Chairman and CEO, Environmental Financial Products; Chicago, Illinois

SESSION IV: AGRICULTURAL ENTREPRENEURSHIP

The session focused on the rapidly-growing agricultural entrepreneurship ecosystem. Entrepreneurial activities encompass small early stage start-ups as well as more established companies. Product and process innovations with a broad range of applications will be discussed in the session, including smart sensors, crop advisory and irrigation management services, and financing and water trading systems. This session used a world café format, which allowed participants to engage in multiple discussions with the featured entrepreneurs about their specific value propositions, business models, challenges of scaling and experiences with agricultural entrepreneurship.

Moderator:

Nick Brozović, Director of Policy, Water for Food Global Institute; Lincoln, Nebraska

Introductory comments:

Richard L. Sandor, Chairman and CEO, Environmental Financial Products, LLC; Chicago, Illinois

World Café Topic Leaders:

Kian Alibakhshian, Founder and CEO, Smart Water Metering, Inc.; Ontario, Canada

Randy Barker, Managing Director, Business Development, FarmLink; Kansas City, Missouri

Brennan Costello, Marketing Lead, Student Entrepreneur, FarmAfford; Lincoln, Nebraska

Barclay Rogers, Co-founder and CEO, Good Earth Irrigation; Livingston, Montana

Adam Wolf, Founder and CEO, Arable; Princeton, New Jersey

Richael Young, Co-founder and President, Mammoth Trading; Program Associate, Water for Food Global Institute, Lincoln, Nebraska

SESSION V: AGRICULTURAL TECHNOLOGY

Effective application of emerging agricultural technologies related to efficient water use will be critical to achievement of sustained global food security. This goal is only possible through integrated, systems approaches to research and development, and innovative partnerships within and across the public and private sectors. This session brought together perspectives across a range of important new technologies, and experience with innovative partnership and development models.

Moderator:

Archie C. Clutter, Dean, Agricultural Research Division; Director, Agricultural Experiment Station, Institute of Agriculture and Natural Resources, University of Nebraska–Lincoln

Speakers:

Michael Dowgert, Vice President of Sales and Marketing, CropX; Tel Aviv, Israel

Daniel Schachtman, Professor, Department of Agronomy and Horticulture, University of Nebraska–Lincoln

Scott A. Shearer, Professor and Chair, Department of Food, Agricultural and

Biological Engineering, The Ohio State University; Columbus, Ohio

Arthur Zygielbaum, Water for Food Global Institute Faculty Fellow and Research Associate Professor, School of Natural Resources, University of Nebraska–Lincoln

SESSION VI: INFORMATION TECHNOLOGY

Panelists discussed their project failures, successes and future opportunities for how to use information technology to collect, analyze and produce stakeholder value-added products to improve agricultural livelihoods. The process of developing and implementing new information technology with stakeholder groups requires functional private-public partnerships. The speakers provided insight into this complex process from their own diverse set of projects involving information technology.

Moderator:

Trenton Franz, Water for Food Global Institute Faculty Fellow; Hydrogeophysicist and Assistant Professor, School of Natural Resources, University of Nebraska–Lincoln

Speakers:

Jay Angerer, Associate Professor, Blackland Research and Extension Center; Director, Center for Natural Resource Information Technology; Senior Scientist, Norman Borlaug Institute for International Agriculture, Global Livestock Early Warning System, Texas A&M University; College Station, Texas

Kelly Caylor, Associate Professor and Director of Princeton Ecohydrology Lab, Department of Civil and Environmental Engineering, Princeton University; Princeton, New Jersey

Colin Everson, Water for Food Global Institute Global Fellow; Hydrometeorologist, South African Earth Observation Network; Honorary Professor, Hydrometeorology and Remote Sensing, University of KwaZulu-Natal; Pietermaritzburg, South Africa

Luke H. MacDonald, Deputy Director, Water Institute, Johns Hopkins University; Baltimore, Maryland

Ammar Wahbi, Technical Officer, Soil and Water Management and Crop Nutrition Section, International Atomic Energy Agency, Joint FAO/IAEA Program; Vienna, Austria

PLENARY SESSION IV: BIG DATA: PARTNERSHIPS TO LEVERAGE DATA FOR WATER AND FOOD SECURITY

Co-convened by the Foundation for Food and Agricultural Research, U.S. Water Partnership and the Water for Food Global Institute

Panelists discussed the challenges, emerging trends, partnerships and the future outlook for Big Data.

Moderator:

Christopher Neale, Director of Research, Water for Food Global Institute; Lincoln, Nebraska

Speakers:

Lee Addams, Co-founder and Chief Operating Officer, Good Earth Irrigation, Livingston, Montana

Kenneth Cassman, Water for Food Global Institute Faculty Fellow; Emeritus Robert B. Daugherty Professor of Agronomy, University of Nebraska–Lincoln

John Gates, Water for Food Global Institute Global Fellow; Senior Hydrologist, The Climate Corporation; San Francisco, California

CLOSING PANEL

Moderator:

Margaret Catley-Carlson, Water for Food Institute International Advisory Panel Member and Vice Chair, Canadian Water Network; Vancouver, Canada

Panelists:

Uma Lele, Independent Scholar and Development Economist; Water for Food

Institute International Advisory Panel Member; Washington, D.C.

E. Robert Meaney, former Chairman International, Valmont Industries, Inc.; Riverside, Connecticut; Daugherty Distinguished Fellow, WFI

Peter Rogers, Gordon McKay Research Professor, School of Engineering and Applied Sciences, Harvard University; Water for Food Institute International Advisory Panel Member; Cambridge, Massachusetts

Ann Willet, Director of Strategic Alliances for Food, Fuel and Water, Nebraska Innovation Campus; Lincoln, Nebraska

Closing Remarks

Roberto Lenton, Founding Executive Director, Water for Global Food Institute; Lincoln, Nebraska

CLOSING PLENARY AND HEUERMANN LECTURE

Something New in Agriculture: Making a 'Foundation' for Funding, Partners and Innovation

Sally Rockey, Executive Director, Foundation for Food and Agriculture Research; Washington, D.C.

In the closing plenary session, Rockey highlighted new ways of thinking about public-private partnerships and how to leverage collaboration to drive innovation in food and agriculture. The lecture included different approaches to public-private partnerships and addressed where those partnerships have the greatest potential for impact in the food and water security space.

CLOSING RECEPTION

Participants enjoyed a Latin American-themed reception in celebration of the 2018 World Water Forum in Brasilia, Brazil. Live music was performed by renowned jazz vocalist Jackie Allen and her Latin jazz band.

Juried Poster Competition

The 2016 Water for Food Global Conference featured a juried poster competition for graduate students. Students had two opportunities to participate: an online competition prior to the conference and an on-site competition. Forty-five posters were entered in response to our call for science that innovatively addresses current research focused on water for food topics. Additionally, in collaboration with the Institute of International Education and the Fulbright Foreign Student Program, a special competition was held for Fulbright scholars. Students whose posters placed in the top six received travel support to the conference and presented their work in the poster session. Faculty, partners and other professionals submitted an additional 11 posters.

Photos of the first place winners are included. Award winners are pictured with Roberto Lenton, founding executive director of the Water for Food Global Institute.

Online Competition

Prior to the conference, 35 students entered an online competition. All winners received cash prizes and free registration to the conference. University of Nebraska faculty and WFI Global Fellows served as jurors for the online competition.

FIRST PLACE (\$1,000): Mesay Alene Eyassu, UNESCO-IHE Institute for Water Education; “The Tradeoff between Integrated Watershed Management and Flood-based Farming System at Raya Watershed in Northern Ethiopia”

SECOND PLACE (\$750): Leah Ruff, Department of Agronomy and Horticulture, University of Nebraska–Lincoln; “Heterosis in Soybean as Drought Tolerance Predictor”

THIRD PLACE (\$500): James Higgins, Department of Computer Science & Engineering, University of Nebraska–Lincoln;

“Robotic Mechanisms for Water Sample and Data Collection”

On-site Competition

All students who registered for the conference and entered the online competition were eligible to present their work at the on-site competition. The prize winners of the on-site competition were determined by a body of academic judges at the conference. All winners received cash prizes and free registration to the conference. (Note: The cash prize was split evenly between the third place and honorable mention finishers because these entries received identical scores.)

FIRST PLACE (\$1,000): Yulie Meneses Gonzalez, Department of Food Science & Technology, University of Nebraska–Lincoln; “Feasibility, Safety, Economic and Environmental Implications of Whey-Recovered Water for Cleaning-In Place Systems: A Case Study on Water Conservation for the Dairy Industry”



On-site first place winner Yulie Meneses Gonzalez with Roberto Lenton



Online first place winner Mesay Alene Eyassu with Roberto Lenton

SECOND PLACE (\$750): Justin Gibson, School of Natural Resources, University of Nebraska–Lincoln; “Estimating Water Savings from Precision Irrigation Techniques in Western Nebraska”

THIRD PLACE (\$250): Juan Jaimes-Correa, Department of Civil Engineering, University of Nebraska–Lincoln; “Use of NEXRAD Data in Hydrologic Modeling of Extreme Hydrometeorological and Climate Events in an Agricultural Watershed”

HONORABLE MENTION (\$250): Azeem Khan, Department of Biological Systems Engineering, Washington State University; “Satellite Remote Sensing of Actual Evapotranspiration from Drylands of Washington State”



Above: First place winning photo by Sudipto Das; Kolkata, India; “Fishing in Shilabati River.”

Photography Contest

The Water for Food Global Institute held its first-ever photography competition in conjunction with the conference. An open call was made to photographers of all skill levels, age 18 or older, from anywhere in the world, asking: “What does ‘water for food’ look like in today’s world?” The photographs were judged by a panel of professional photographers and were on display during the event.

FIRST PLACE (\$100): Sudipto Das; Kolkata, India; “Fishing in Shilabati River”

FIRST RUNNER-UP (\$75): Khalid Shawon; Dhaka, Bangladesh; “Rain: The Pure Source of Drinking Water”

SECOND RUNNER-UP (\$50): Erik Johnson; Lincoln, Nebraska; “In Retirement”

VIEWERS’ CHOICE: Jill Weiser; Shelton, Nebraska; “Windmill”



View all the photo entries on our Facebook page.



Participants view the photography contest exhibit.

Conference Photos



Chittaranjan Ray of the Nebraska Water Center and Margaret Catley-Carlson of the Canadian Water Network visit with colleagues.



WFI's Molly Nance and Peter McCornick lead a small group discussion during the workshop on "Opportunities and Challenges of Expanding Smallholder Irrigation in sub-Saharan Africa."



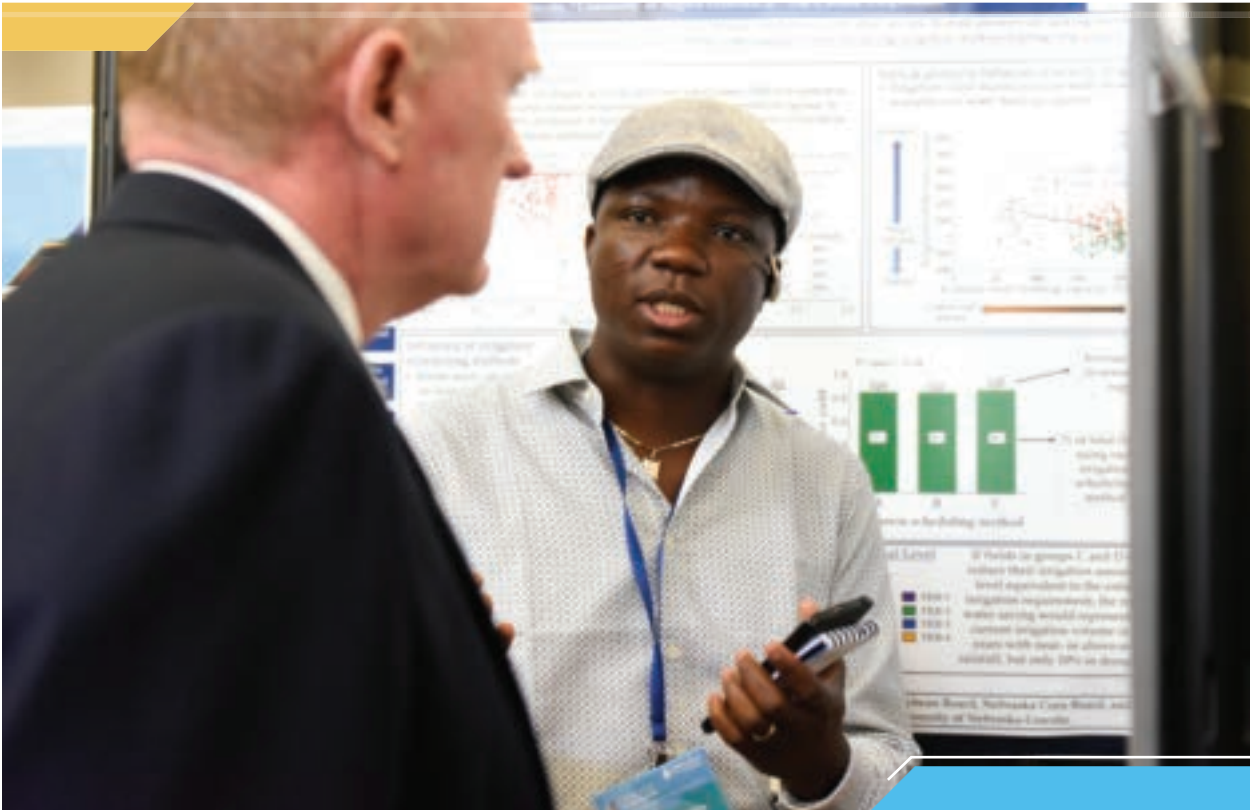
From left: James B. Milliken, The City University of New York; Debra Leigh, Leigh Environmental Equipment and Dale Jacobsen, World Water Council.



Alie Kamara, University of Illinois



From left: Khaldon H. Khashman, Arab Countries Water Utilities Association; Nick Brozović, Water for Food Global Institute; Kian Alibakhshian, Smart Water Metering and John Wilson, USAID.



Manzamasso Hodjo of New Mexico State University discusses his research.



Guests walk the red carpet to the Van Brunt Visitors Center for the opening reception and “Thirsty Land” film premiere.



Ivo Zution Goncalves, WFI; Ricardo Gava, Federal University of Mato Grosso do Sul; Michael Neale, Colorado State University and Isidro Campos, University of Castilla-La Mancha.



Francisco Munoz-Arriola, University of Nebraska–Lincoln



A delegation of six Fullbright students participated in the conference.

Back row, from left: Roberto Lenton, WFI; Manzamasso Hodjo, New Mexico State University; Jesse Starita, WFI; Rulianda Wibowo, Kansas State University; Stanley Dary, University of Missouri and Tom Farrell, UNL

Front row, from left: Luwianca Giselle Gil Moreno, Old Dominion University; Richa Niraula, University of Illinois at Urbana-Champaign and John Christian Abu-Kpawob, Purdue University



Participants enjoy music and refreshments prior to the farm-to-table dinner at the Cornhusker Marriott Hotel.