Jeff Raikes

Chief Executive Officer, Bill and Melinda Gates Foundation

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Keynote Address: Fighting Poverty with Water

Improving agricultural productivity in poor countries is one of the most effective ways to fight hunger and poverty. But several water crises – from overuse to underuse, climate change to changing patterns of water use – threaten to block that pathway to prosperity. Addressing these crises successfully, and therefore helping hundreds of millions of people lift themselves out of poverty, will require us all to think about water problems and solutions boldly.

James Goeke
Professor, Survey Division, School of Natural Resources, University of Nebraska–Lincoln

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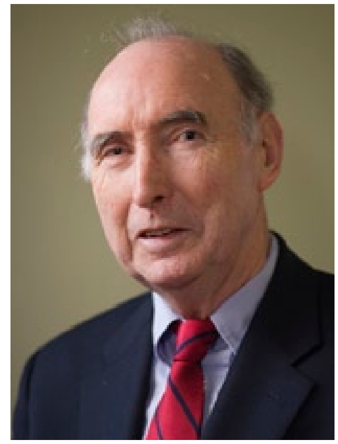
The Significance of Water to Nebraska

Water is particularly significant in Nebraska as a transition state between the moist midcontinent and the semi-arid west. With an average annual precipitation of 22.78 inches, additional water is needed to maintain Nebraska's ranking as the most irrigated state with 8.6 million irrigated acres, 1.4 million from surface water and 7.2 million from groundwater.

Obviously the "Good Life" in Nebraska has its roots in Nebraska's water resources. The Nebraska Conservation and Survey Division and the U.S. Geological Survey have worked together for more than 100 years to inventory and monitor Nebraska water resources. The 1980 USGS High Plains Regional Aquifer Systems Analysis, covering most of Nebraska and parts of Kansas, South Dakota, Wyoming, Colorado, Oklahoma, New Mexico, and Texas, estimated total groundwater storage in these eight states at 3.25 billion acre feet. Nebraska accounted for 66 percent, or 2.145 billion acre feet; Texas, 12 percent; and Kansas, 10 percent. Depletions in 1980 were 166 million acre feet with 70 percent in Texas, 16 percent in Kansas and 0 percent in Nebraska. However, a generalized model predicting from 1980 to 2020 indicated potential for significant declines in Nebraska.

In Nebraska, surface water control was initiated in 1895 under the Prior Appropriations Doctrine, stating first in time, first in right. It wasn't until 1975, with the passage of the Groundwater Management Act, that groundwater management was charged to the 23 Nebraska Natural Resources Districts (NRDs) under the Correlative Rights Doctrine. Legislation in 1996 formally recognized the connection between surface water and groundwater. In 2004 LB 962 provided for the integrated management of hydrologically connected waters and currently all NRDs are developing Integrated Management Plans. Detailed models such as the COHYST model have been developed to determine stream depletion factors that have been imposed and most of the state has been or will be designated as either over appropriated or fully appropriated, mandating the integrated management plans. Just as barbed wire and windmills closed the "open range" in the 1880s, so do these events close easy access to groundwater in Nebraska.

The future is yet bright for Nebraska. Surface water and groundwater will be used ever more efficiently to maintain profitable agriculture, necessary streamflows and stable water levels. Since supplemental irrigation uses are less than 10 percent of the total annual supply in Nebraska, water budgets will promote research to save water in creative ways without requiring that all savings be from irrigators.



Peter P. Rogers

Gordon McKay Professor of Environmental Engineering, Harvard University

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The Role of Irrigation in Meeting the Global Water Challenge

The demand for fresh water is rising rapidly because of increasing populations, higher standards of living, and increasing consumption of goods and services. At the same time, the impacts on aquatic ecosystems are becoming more intense, and rising temperatures signal a changing climate and more variable water supplies. The conjunction of these facts could lead to a global water crisis. However, the most important trigger of the water crisis is the management of irrigation. This presentation looks at the demands of all kinds of water users – agriculture, domestic, industry and ecosystems – and matches them with new and emerging technologies. The presentation concludes there is no necessity for major water shortages over the next 50 years. However, humans' abilities to make bad decisions should not be underestimated.

Simi Sadaf Kamal

Chairperson and Chief Executive, Hisaar Foundation

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Use of Water for Agriculture in Pakistan: Experiences and Challenges

Pakistan is basically an arid country with 92 percent of its land area classified as arid or semi-arid. It would not have been a food-producing country without irrigation. Pakistan is said to have the largest contiguous irrigation system in the world, with three major dams, several barrages, numerous weirs, and a comprehensive system of main canals, distributary canals and water channels. Irrigation and agriculture consume 97 percent of Pakistan's allocated surface water resources of 117 million acre feet. Pakistan's irrigated area is about 80 percent of all cultivated area in the country and produces 90 percent of all its food and fiber requirements. Pakistan is known for its "green revolution" of the 1960s, and about 25 percent of Pakistan's GDP currently comes from agriculture. It has an established system of water sharing and water rights for agriculture, which has some aspects of good practice, but this has remained essentially unchanged since the country's birth. The Indus basin also has fresh groundwater reserves of about 55 million acre feet, most of it already mobilized for agricultural production, largely in conjunctive use with surface water. This conjunctive use also is cited as a best practice in some quarters.

Within this context, this presentation examines how the ways of sharing and using irrigation remain the same, while the realities of water availability, water regime, climate, river and delta conditions have changed, causing huge strain on the system and large-scale degradation of the resource base. Thirty-eight percent of Pakistan's irrigated lands are waterlogged and 14 percent are saline. This means only 45 percent of possible cultivated land is under crops at any given time. Agricultural productivity per unit of land and water remains very low.

There is saline water intrusion into mines, aquifers and delta channels, and water table decline in other parts of the country. These challenges are compounded by infrastructure inefficiencies, water pollution, increasing effluents and a rising population demanding more water for food production. However, the prevalent debate continues to be hinged on the provincial distribution of surface water, which, in the speaker's view, draws attention away from the real issues of water use.

The presentation also examines the irrigation water vs. environmental flow requirements, low water storage capacity, disposal of salts and pollutants, and the growing urban, domestic, sanitation and industrial needs. It also examines low irrigation service charges and how this contributes to system inefficiencies.

The conclusion is that Pakistan can meet its future challenges relating to water use, but it will not be through business as usual. A paradigm shift will be required to reframe the discourse on water. The elements of this shift will be discussed, and some future best practices will be outlined.

Richard G. Allen

Professor of Water Resources Engineering,
University of Idaho

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Water Science and Research Issues Associated with the Future of Water for Food

As professionals in water, food, economics and policy gear up to address future challenges in producing food for a growing population and growing water scarcity, better tools need to be built, refined and applied to better quantify what we will need to better manage. Economically efficient food production will require more effective management and consumption of freshwater resources. That management will require better quantitative tools and understandings than are practiced now. One cannot manage well what one cannot measure, especially within the highly spatial structures of natural resources.

Irrigation will continue to be a substantial factor in increasing food production. Methods must be developed to determine how to produce more reliable water supplies, or water supplies that can be used more effectively. New supplies will range from millions of micro-streams produced from human-powered treadle pumps to large reservoirs.

Research issues associated with these supplies will range from improving means to sustain groundwater systems long term to mitigating toxic groundwater chemicals and impacts of depletion on hydro-ecology. Physical and social sciences must improve our ability to assess and weigh ultimate outcomes of concentrating people and agriculture along river corridors vs. having the same populations distributed with slash-and-burn food production systems.

Water productivity increases ("more crop per drop") need to include consideration of externalities associated with crop production and water consumption; for example, growth of local economies stemming from production of higher value crops promoted by better-insured water supplies, local food security and diet, and negative and positive hydrologic impacts of water conservation and supply management. We must boost the application of accurate water accounting around the globe from continent to micro scales. Research and engineering must formulate more expanded yet more fluid and simple data information structures and hydrologic simulation methods to support water supply and hydrologic evaluations that begin at the basin scale (to provide the primary indication of the currently available supply of "unconsumed" water at current usage levels and manner of usage) and then progress upstream with more and more detailed focus. These approaches are already applied in some basins such as the Nile and by some entities including the International Water Management Institute and the World Bank.

Science and research need to improve the means to descriptively parse the disposition of diverted water – for example, via the computation of the consumed fraction of diverted water vs. the non-consumed fraction, the beneficially consumed fraction vs. the non-beneficially consumed fraction, and the re-used fraction vs. the non-reuseable fraction. These types of fractions are needed to paint visual images of hydrologic and production realities to policymakers and managers and to provide hydrologists and planners with accurate water balances and accounting methods.

Quantification of water supply and use requires tools that determine the spatial structure of water consumption over large areas. These tools are currently under development and include satellite-based means to estimate real water consumption via a complete surface energy balance, such as processing models SEBAL and METRIC that are in use in more than 15 U.S. states, including Nebraska, and more than 30 countries. These models can be outfitted to estimate biomass production per unit of water consumed. Better algorithms and smarter calibration, coupled with more and higher-resolution satellites, are needed to make these approaches mainstream around the globe.

Climate change is likely to modify the distribution of precipitation locally and globally and change the partitioning of liquid vs. solid precipitation and synchronization of snowmelt in temperate regions with irrigation needs. Climate change will likely lengthen growing seasons and increase environmental stresses on food crops and natural systems via higher temperatures and lower relative humidity. We must be ready.

Robert Glennon

Morris K. Udall Professor of Law and Public Policy,
University of Arizona College of Law

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America's Water Crisis and What to Do About It

The water supply that Americans depend on for human and agricultural needs is dwindling. The country now faces difficult choices about how to preserve its water supply for future generations.

In his newest book, *Unquenchable: America's Water Crisis and What to Do About It*, Robert Glennon describes the extravagances and wasteful practices that are endangering water supplies across the country. The problem is exacerbated by the growth of clean energy sources such as ethanol and biofuels, which require thousands of gallons of water during the manufacturing process.

The country's looming water shortage could have numerous social, environmental and political consequences. Glennon argues these issues can't be solved through traditional fixes such as water diversion or outrageous schemes to tow icebergs from Alaska. He advocates a market-based system that values water as a commodity and a fundamental human right. During his presentation, he will discuss his book and his ideas for dealing with the nation's water challenges.