TECHNOLOGY IMPLEMENTATION IN AGRICULTURE FOR ENHANCING CROP WATER PRODUCTIVITY (MORE CROP PER DROP)

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“SETTING THE STAGE”

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NC-FAR Capitol Hill Lunch-N-Learn

February 8, 2016

Photos Courtesy: Jeff Reutter, Lonnie Thompson, Reagan Waskom, Rebecca Power
Water Challenges Are Nationwide

Projected Population Growth (2000-2020)

Total Freshwater Withdrawal / Available Precip
- >500%
- 100 to 500%
- 30 to 100%
- 5 to 30%
- 1 to 5%
- 0 to 1%

Source: NETL (2002)

(Roy et al, 2003)
Mississippi River and Gulf of Mexico Hypoxia
Hypoxia in the Gulf of Mexico

Data: Nancy Rabalais, LUMCON and R. Eugene Turner, LSU.
Lake Powell Summer 2004, 120’ low, ~10 maf remaining, 15 maf gone.
88.3% of the ice present in 1912 has disappeared.
40% of the ice present in 2000 had disappeared by 2013.

Total Area Of Ice On Kilimanjaro

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The world’s population has been increasing significantly from about 3 billion people in 1960 to 4 billion in 1974, 5 billion in 1987, 6 billion in 1998, and about 7.3 billion in October 2015 with an astonishing growth rate of about 80 million people a year!
World’s population might reach over 9 billion by year 2050, based on the current rate of population growth. Increasing limitations in freshwater resources coupled with population growth have increased the competition for water between various sectors and will likely continue to increase the pressure on all disciplines to use water resources more efficiently. However, this pressure will most likely be imposed on irrigated agriculture more than other sectors because over 70% of the total freshwater resources withdrawn worldwide is withdrawn (not used!) for irrigated agriculture (Irmak, 2015a and b).
Importance of irrigation today

Irrigation remains vitally important in the USA and worldwide as a means to enhance agricultural productivity.

Today, irrigation continues to play a crucial role in meeting the food and fiber demand of a rapidly growing modern civilization as irrigated agriculture currently contributes to about 40% of the world's total food and fiber production on only (irrigated) 20% of the total cultivated land.
Irrigated land--World

World: 806 million acres
China: 158 million acres
India: 154 million acres
USA: 55 million acres
Nebraska is ranked 1st in the Nation in terms of irrigated land (>9 million acres) with more than 115,000 active irrigation wells.
Challenges!

Maximizing the net benefits of irrigated and rainfed crop production while reducing potential negative environmental impact(s) through appropriately designed agricultural water management programs is of growing importance in Nebraska, USA, and around the world because many areas are involved in management and policy changes to conserve water and energy resources used in agro-ecosystem production.

Farmers are being challenged to practice conservation methods and use water resources more efficiently and reduce unbeneficial use of water resources while meeting crop water requirements for maximum net return.
Well-designed Agricultural Water Management Programs that Link Research and Extension are the key to overcome some of these challenges!

Effective Extension programs enable adoption of good management practices to make an impact on the ground!
The NAWMN main goal:

- The NAWMN is the largest and most comprehensive agricultural water management program in the United States.
- The main goal of the Network is implementation of technology as well as research and scientific-based information in agriculture to enhance productivity and minimize environmental impact(s) of irrigation.

Specific goals include:
NAWMN specific goals

• Transfer high quality research information on soil water status and crop water use measurements to farmers and their advisors through a series of demonstration projects established in growers fields.

• Foster adoption of newer irrigation water management technologies to help farmers to increase water use efficiency, save water, reduce energy consumption, and protect environmental services.

• Enhance communication and enable idea and information exchange between growers, crop consultants, academics, NRDs, NRCS, DNR, irrigation districts, etc.

• Educate Nebraska youth on soil and water resources and advanced/next generation technologies.
NAWMN specific goals

• Develop next generation water, soil, and crop management tools to continue technology implementation in agriculture and be recognized as one of the best in agricultural research and education in the nation/world.

• Quantify short- and long-term measurable impacts in terms of environmental and economical impacts of the Network
Irrigation management technologies initially implemented
Granular matrix sensors to monitor soil moisture

- Electrodes
- Sensor collar
- Hand-held meter

Stainless steel sleeve
Electronic tipping bucket rain gage

Soil temperature sensor

Rain gage adaptor attached to port #8

Watermark Monitor datalogger
Capacitance sensor
ATMOMETER (ETgage) to monitor crop water use locally

Bird spike
Sight tube and scale
300 mm (11.8 in) capacity water reservoir

Bellani plate (ceramic evaporation surface)
Rubber stopper
Suction tube
Dr. Irmak educating/training Extension Educators first before going out to the field to educate/train NAWMN cooperators and teach them how to install and read the sensors and incorporate the data into irrigation management decision-making.
Extensive on-farm demonstration projects (over 400) have been established in many farmers’ fields over the years to teach about advanced soil and water management strategies and tools.

Sensor installation demonstration by Extension Educator Darrel Siekman
Sensor installation demonstration by Extension Educator Jenny Rees
In-field teaching of effective tools/technologies to farmers
Datalogger programing Sensor installation demonstration
One-on-one education/teaching/demonstration is the key for successful implementation and adoption of newer technologies by farmers for water and energy conservation. Demonstration by Extension Eucator Brandy Van DeWalle.
One-on-one interaction provides unique opportunities for more effectively educating farmers and answer their questions about real-world issues in the field. This also results in developing strong relationships and trust and confidence between us and farmers and helps to adopt our suggestions into their farming practices. ETgage demonstration by Dr. Suat Irmak.
All the information and data from the Network are shared on the NAWMN website for farmers and other to use in their farming management decisions who may not be collaborator in the Network.

http://water.unl.edu/cropswater/nawmn


The app estimates the water used and water still available for various soils types. User can also see historic sensor readings, graph the data, and pin his/her GPS locations.
Impact: Number of farmer cooperators in the NAWMN

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<th>Year</th>
<th>Number of farmers as cooperators</th>
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<td>2015</td>
<td>140</td>
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Reduction in irrigation water withdrawal per growing season

![Graph showing reduction in water withdrawal from 2005 to 2015 with a long-term average of 2.2 inches per growing season and a trend line showing an increasing trend.](image-url)
Lake McConaughy capacity = 1,740,000 ac-ft (almost 20% of LM capacity in 2012 alone)
At least $80 Million saved in energy costs from 2005 to 2013
Locations of each cooperator field
The Network was formed with only 15 farmers as collaborators in only one of the 23 NRDs in 2005.

Because of the extensive information and data taught in the NAWMN, farmers and consultants are changing their behaviors of how they manage irrigations and the Network is having significant impacts in terms of conserving water and energy resources statewide.

As of late 2013, the number of active collaborators has increased to 1,393,100 in 18 NRDs and 70 of 93 counties.

Since the beginning of the NAWMN, over 10,000 farmers, crop consultants, and agricultural industry personnel have been reached and educated at over 500 Extension programs/meetings.

NRDs are cost-sharing the technology/equipment for farmers up to 50-75% of the total cost.

Some of the findings and practices developed in the NAWMN are implemented into the national NRCS soil and water conservation incentive programs...
Statements from farmers about NAWMN

- “This program saves water and energy without compromising yield! Great leadership by UNL Extension and the NRD!”

- “Hands on help to understand the use of soil moisture sensors and ETgage.”

- “Witnessing first hand that the technology works and that we saw a significant water savings.”

- “This was my first year and I liked all the support and guidance I received from your staff. They were VERY helpful in helping me understand how to use my equipment.”

- “Network provides tools and resources to improve irrigation scheduling and saves water and pumping costs while maintaining crop yields.”

- “UNL Extension & NRD staff members have been very helpful in helping me gain confidence in the technology.”

- “It gave me more education and information than I could not have gotten anywhere else - hands on.”
In-field teaching... Dr. Suat Irmak and his team uses NAWMN platform to educate and enhance scientific literacy of farmers, crop consultants, state and federal agency personnel, and other professionals in various topics related to water, crop production, crop physiology, climate, evapotranspiration, soil-water-plant-atmosphere continuum.
Evapotranspiration (crop water use) research

Subsurface drip irrigation research

Vineyard and switchgrass water use

No-till research

Cover crops impact on soil quality

Remote sensing-satellite technology for regional assessments
Statewide long-term corn and soybean crop water use efficiency trends

The CWU increased by 36% for corn and 31% for soybean and trends continued into 2014 (Irmak and Sharma, 2015)
Huge thank you!

Ronnie Green
Ron Yoder
Chuck Hibberd
Jenny Rees
Gary Zoubek
Brandy VanDeWalle
Dan Leininger
Rod DeBuhr
Randy Prior
Aaron Nygren

1,393 wonderful Nebraska farmer cooperators!
Thank you!

“Science is the father of knowledge, but opinion breeds ignorance.” Hippocrates, 460 BC – 370 BC.

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