THE UNIVERSITY OF ARIZONA

Water Resources Research Center

College of Agriculture and Life Sciences

Water, People, and the Future: Water Availability for Agriculture – and others – in the United States

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USDA Agricultural Research Service
Water Availability & Watershed Management
Customer/Stakeholder Workshop
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WSP Center

www.cals.arizona.edu/azwater

Will talk about

- The University of Arizona Water Resources Research Center and our programs
- The CAST (Council for Agricultural Science and Technology) Issue Paper Number 44, “Water, People and the Future: Water Availability for Agriculture in the United States,” November 2009
- The challenges of meeting water demands of all the sectors, including the environment in the context of the ARS Strategic Vision for Water Availability and Water Management (2009)

From ARS Water Availability and Water Management Strategic Vision

- Manage the Nation's agricultural resources
- Develop technologies and strategies to restore stream corridors… and to reduce the transport of nutrients, pathogens….
- Results will provide the technologies to manage and deliver safe and reliable fresh water supplies to the agricultural, urban and industrial sectors of society while enhancing the aquatic natural resources of the Nation.

WRRC Mission

The University of Arizona Water Resources Research Center (WRRC) promotes understanding of critical state and regional water management and policy issues through research, community outreach and public education.

The WRRC is committed to:

- assisting communities in water management and policy;
- educating teachers, students and the public about water; and
- encouraging scientific research on state and regional water issues.

One of five water centers at the University of Arizona that manage the university-wide Water Sustainability Program

Member of National Institutes for Water Resources (NIWR)

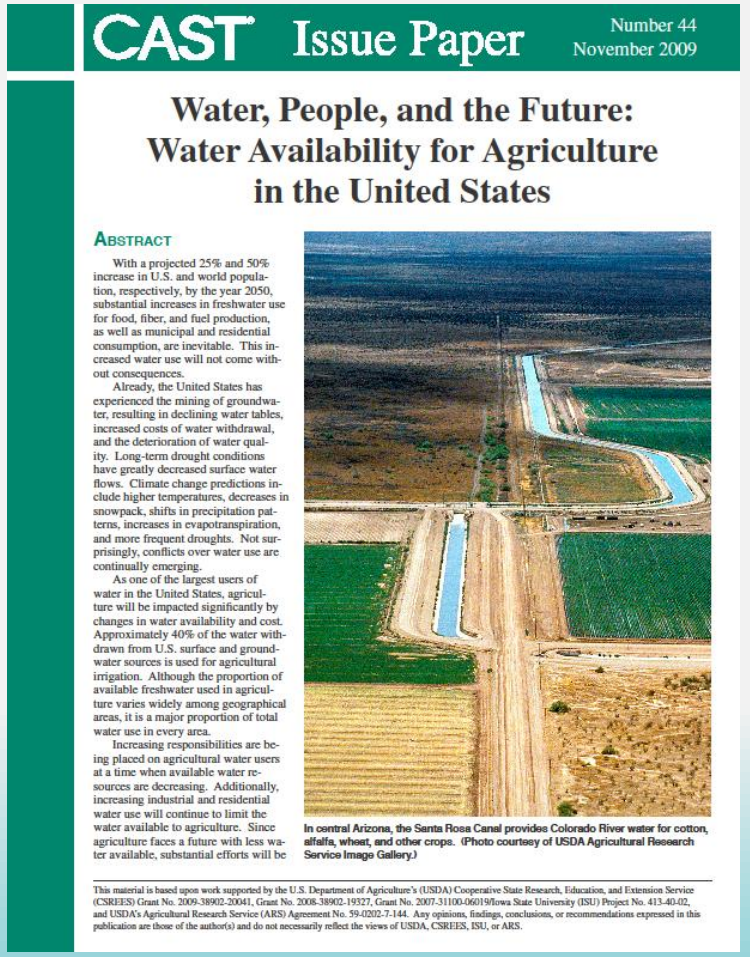
Web site: www.cals.arizona.edu/azwater

WSP
Water Sustainability Program
Our Water Future

Some Ongoing Programs/Projects

- "Conserve to Enhance": How to obtain funds to purchase water for the environment?
- Statewide Environmental Water Needs Assessment
- Paper on the Environment as the forgotten sector in Arizona
- U.S.-Mexico Transboundary Aquifer Assessment Program: Federally authorized program to assess aquifers that cross the borders
- Water planning listening sessions
- Edited volume based on Arizona-Israeli-Palestinian Water Management and Policy Workshop
- Annual conference, seminars
- Teach Graduate Level Arizona Water Policy Course
- Others direct Arizona Project WET & Arizona NEMO

Cast Issue Paper



CAST Issue Paper Number 44 November 2009

Water, People, and the Future: Water Availability for Agriculture in the United States

ABSTRACT

With a projected 25% and 50% increase in U.S. and world population, respectively, by the year 2050, substantial increases in freshwater use for food, fiber, and fuel production, as well as municipal and residential consumption, are inevitable. This increased water use will not come without consequences.

Already, the United States has experienced the mining of groundwater, resulting in declining water tables, increased costs of water withdrawal, and the deterioration of water quality. Long-term drought conditions have greatly decreased surface water flows. Climate change predictions include higher temperatures, decreases in snowpack, shifts in precipitation patterns, increases in evapotranspiration, and more frequent droughts. Not surprisingly, conflicts over water use are continually emerging.

As one of the largest users of water in the United States, agriculture will be impacted significantly by changes in water availability and cost. Approximately 40% of the water withdrawn from U.S. surface and groundwater sources is used for agricultural irrigation. Although the proportion of available freshwater used in agriculture varies widely among geographical areas, it is a major proportion of total water use in every area.

Increasing responsibilities are being placed on agricultural water users at a time when available water resources are decreasing. Additionally, increasing industrial and residential water use will continue to limit the water available to agriculture. Since agriculture faces a future with less water available, substantial efforts will be

In central Arizona, the Santa Rosa Canal provides Colorado River water for cotton, alfalfa, wheat, and other crops. (Photo courtesy of USDA Agricultural Research Service Image Gallery.)

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CAST
The Science Source for Food, Agricultural, and Environmental Issues

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Four case studies

- California
  - Large state with large and growing population
  - Large agricultural sector
- Arizona
  - Rapidly growing urban population
  - Large agricultural sector
  - Water-scarce state
- Florida
  - State with significant water supplies and agriculture
  - Water supply challenges exist
- High Plains Aquifer Region
  - Sizable High Plains aquifer is being depleted
  - Population growth not the factor it is in the other three regions

Federal nexus throughout Case Studies

- Federally funded/constructed projects
- Endangered Species Act
- Clean Water Act and
- Safe Drinking Water Act
  - New constituents
  - Changing standards for naturally occurring constituents, e.g. arsenic
- Shared borders

Differences and similarities abound across the case studies

- There is wide diversity in availability, distribution, consumption, and regulation of surface water, groundwater and treated water
  - Reflective of decentralized approach to water management in United States
- Each state or region increasingly is concerned with the ability to meet future demand of diverse users
- Although the proportion of available freshwater used in agriculture varies widely among the case studies, it is a major proportion of total water use in every area

Changing agricultural water use

- Increasingly, regulatory considerations related to water quality and the environment are affecting agricultural water use
- Agricultural lands are being urbanized, resulting in decreased water use by ag
- Other voluntary transactions are likely to decrease ag water use, such as dry-year options to address drought or other, longer-term transactions, such as those in California
- Competition for water supplies
- Conservation practices

California


Tule Lake
Clear Lake
Trinity Lake
Shasta Lake
Whiskeytown Lake
Corning Canal
Red Bluff Diversion Dam
Lake Almanor
Black Butte Reservoir
Tehama-Colusa Canal
Stony Gorge Reservoir
Glenn Colusa Canal
East Park Reservoir
Lake Orovile
Indian Valley Reservoir
New Bullards Bar Reservoir
Lake Mendocino
Englebright Reservoir
Clear Lake
Lake Tahoe
Lake Sonoma
Folsom Lake
Lake Berryessa
Folsom South Canal
North Bay Aqueduct
Mokelumne Aqueduct
Hetch Hetchy Aqueduct
Camanche Reservoir
New Melones Lake
Grant Lake
Contra Costa Canal
Los Vaqueros Reservoir
New Don Pedro Lake
Lake Crowley
Lake McClure
South Bay Aqueduct
Delta-Mendota Canal
Millerton Lake
Santa Clara Conduit
Madera Canal
Pine Flat Lake
Hollister Conduit
San Luis Reservoir
San Luis Canal
Friant-Kern Canal
Lake Kaweah
Coalinga Canal
Success Lake
San Antonio Reservoir
California Aqueduct
Isabella Lake
Los Angeles Aqueduct
Nacimiento Reservoir
Cross Valley Canal
Twitchell Reservoir
Cachuma Reservoir
Castaic Lake
Lake Casitas
Silverwood Lake
Lake Perris
Colorado River Aqueduct
Lake Mathews
Diamond Valley Lake
Hemshaw Reservoir
Coachella Canal
San Diego Aqueducts
San Vicente Reservoir
All American Canal
Lower Otay Reservoir
State Project
Federal Project
Local Project
NC
NL
SR
SF
SJ
TL
CC
SL
SC
CR
Legend
North Coast
San Francisco Bay
Central Coast
South Coast
Sacramento River
San Joaquin River
Tulare Lake
North Lahontan
South Lahontan
Colorado River

California Snapshot

- Population expected to increase from approximately 35 to 59 million by 2050
- The additional demand will be met largely by conservation, reuse, and retirement of agricultural water uses (land conversion)
- The water landscape is driven by the temporal and spatial disconnect between the major source of water and the water users
  - Insufficient storage for long-term droughts
- Major agricultural activity, including dairies (15% of nation's milk and cheese supply)
  - Approximately 1/3 of applied agricultural water percolates back to groundwater or returns to streams as tailwater

State policies

- State funding for water projects requires <u>Integrated Water Resources Management Plans</u>
  - Water quality across jurisdictional boundaries
  - Surface water and groundwater rights
  - State and federal laws

- Another factor driving regional water management: Water supply assessments for new subdivisions of 500 or more units prior to getting land development permit from local land use agencies. <u>Complete basin analysis is required.</u>

Meeting water demands in CA will require

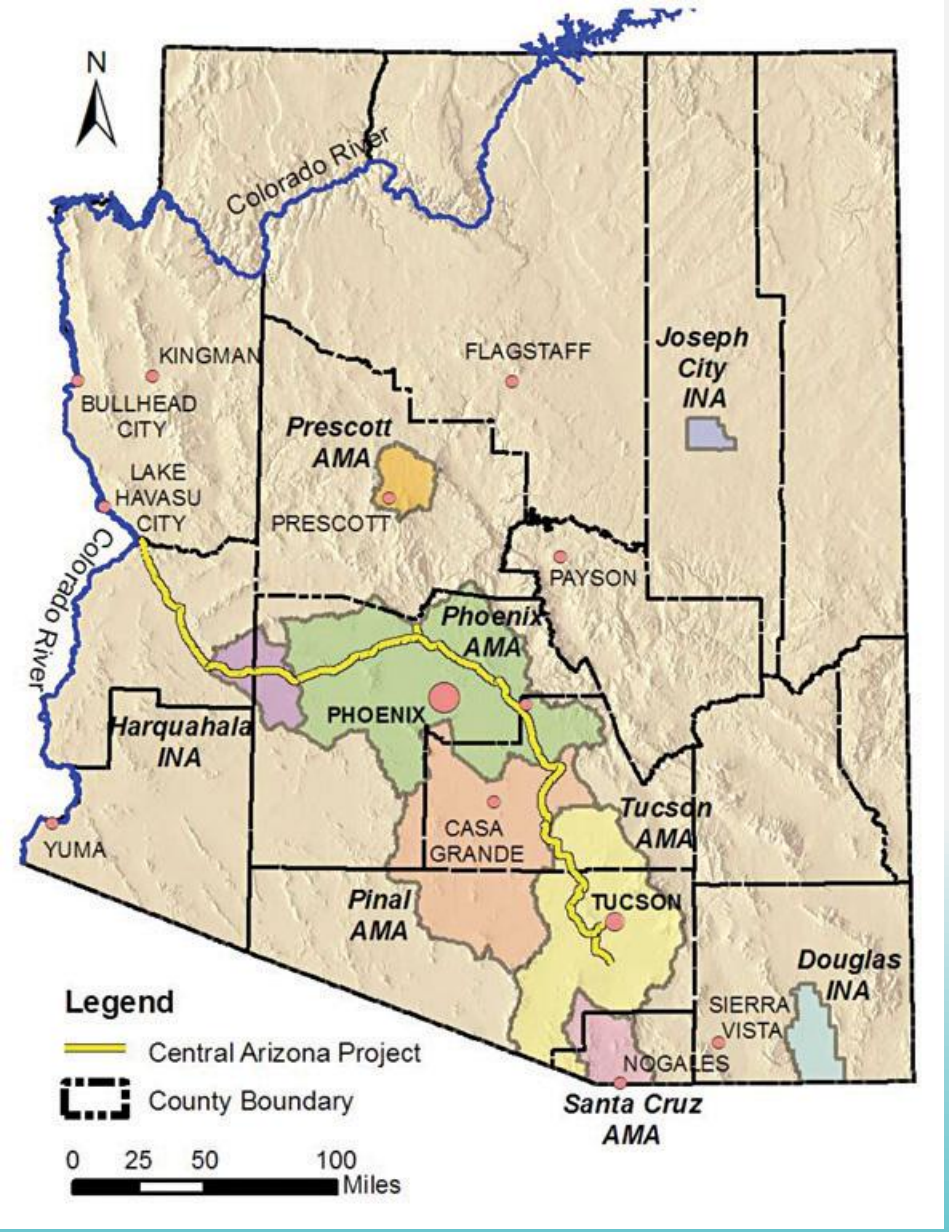
- Expansion of groundwater banking, possibly combined with expansion of surface water storage
- Improved conveyance through or around the Bay-Delta region
- → Decrease in consumptive use of water, particularly by urban sector, which will continue to expand into CA ag lands
- Water conservation and reuse
- Desalination
- → Continued improvement to irrigation efficiency and agricultural productivity

California Case Study Conclusion

"At the regional and statewide levels, permanent, long-term decreases in water supply to agriculture translate directly into decreased agricultural production, even if irrigation efficiency is increased. Hence, the political leadership and the people of California ultimately need to determine the degree to which the state wants to support food and fiber production in light of the trade-offs associated with urban and environmental water needs." (p.8)

Arizona

- Two major Reclamation Projects
  - Salt River Project (SRP)
  - Central Arizona Project (CAP)
- Since 1980, Groundwater management in the Active Management Areas (AMAs)
- Agriculture expansion limited in AMAs and irrigation Nonexpansion Areas
- Non-Indian agricultural water use is diminishing as lands are urbanized in central Arizona
- Agricultural activity is increasing in some non-AMA areas of the state



Arizona Snapshot

- Population of 6.5 million people expected to almost double by 2050. Typically at or near the top of the list for population growth

- Water use estimated to be between 7 and 8 Million Acre Feet (MAF)
  - Approx. 40% of total use is groundwater
  - Approx. 3% is recycled or reclaimed water
  - Of the remaining use, which is surface water, 2.8 MAF is from the Colorado River
    - 1.5 MAF of that is delivered through the CAP

- Approx. 70% of water diverted or extracted by agriculture
  - (issues related to measurement of agricultural water use and relationship of efficiency to incidental recharge)

AZ Water Management Policy

- AMA Assured water supply program requires demonstration of 100 years of legally, physically, and continually available water for new residential development
- Significant use of recharge and recovery programs in AMAs. Agriculture partners with cities to use surface water in lieu of groundwater. But this does not necessarily imply sustainable groundwater use.
- Conservation regulations in the AMAs for all large water users, including ag
  - Best Management Practices
- Drought planning requirements
- No statewide water plan required
- Environmental water use recognized in state reports in very limited way, by state law even less
- Groundwater overdraft continues in many areas

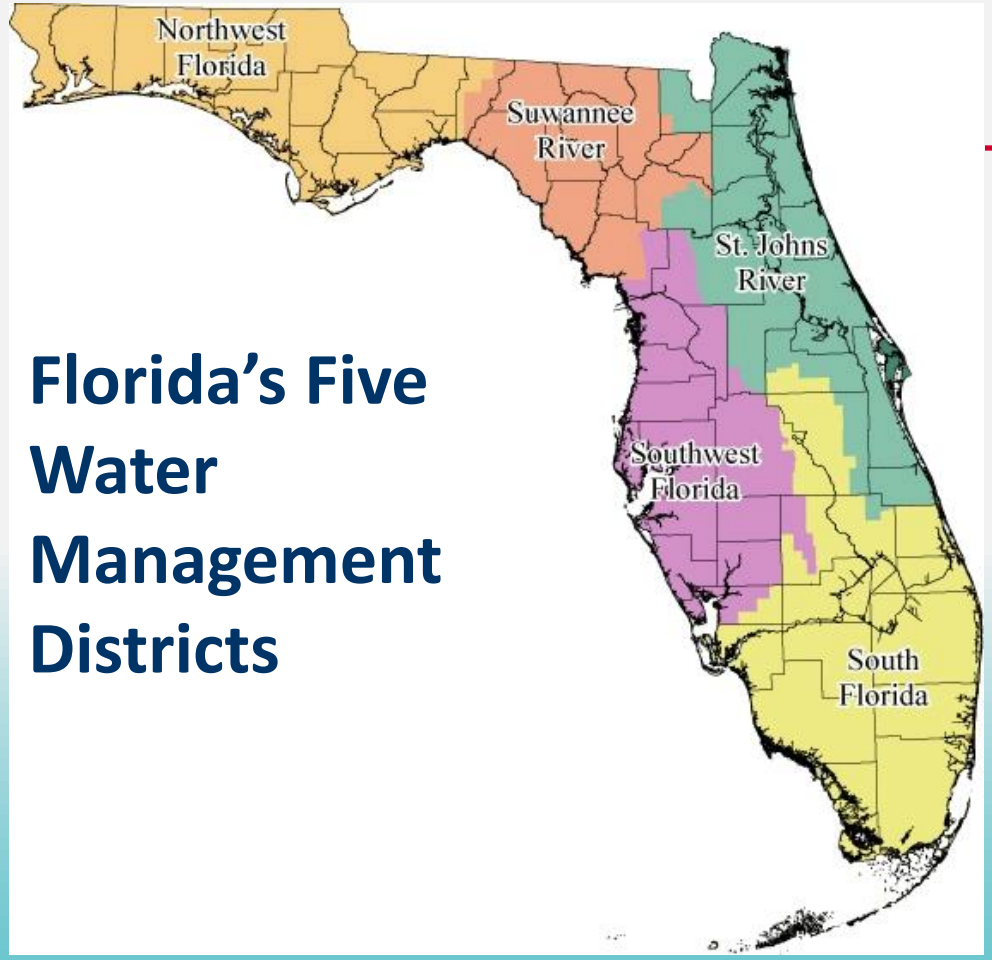
Arizona Conclusion

"…in addition to remaining challenges within the AMAs, there is a need to understand the growing – and often competing – demands for water….Rapid population growth, continuing drought, and impacts of climate change are additional factors making water management in Arizona challenging and careful water planning imperative." (p. 12)

Update: State budget problems are affecting significantly Arizona Department of Water Resources personnel and programs

Research is sorely needed!

Florida



Florida's Five Water Management Districts

- Population of approx. 18 million is largely urban and expected to increase to 26.5 mil by 2030
- Agriculture uses more than half of freshwater
  - About half of this is groundwater
- Agribusiness in FL is 9th largest in U.S. ($7.8 billion in 2005)
- Abundant groundwater
- More than 7,800 lakes

Florida Water Management

- 1972 Water Resources Act delegated water management to five regional districts covering entire state.
  - District boundaries follow surface hydrologic boundaries and cut political boundaries, including cities
- Districts permit consumptive use for a maximum of 20 years but usually much less
- Effect of water withdrawals on natural ecosystems is a consideration
  - "Criteria for the limit of acceptable environmental impacts caused by water withdrawals are established based on minimum flows and levels in surface waters and aquifers…"
- the effects of pollutants from nonpoint sources on Florida ecosystems are increasingly of concern

Water is abundant in Florida

- As a result of conversion of agricultural land to urban uses, by 2025 public water supply will supplant agriculture as the largest freshwater use category
- Nevertheless, "water resource allocation is a problem of spatial and temporal variability…certain parts of the state do not have enough water locally to support continued large-scale development." (p.13)

Moving toward sustainability in FL

- Having enough for future generations
- Economic, social, and environmental considerations
- Major constraint on water withdrawals for human use is regulatory protection of water for ecosystems
- Expansion of use of reclaimed water for urban, household turf irrigation in lieu of good quality water

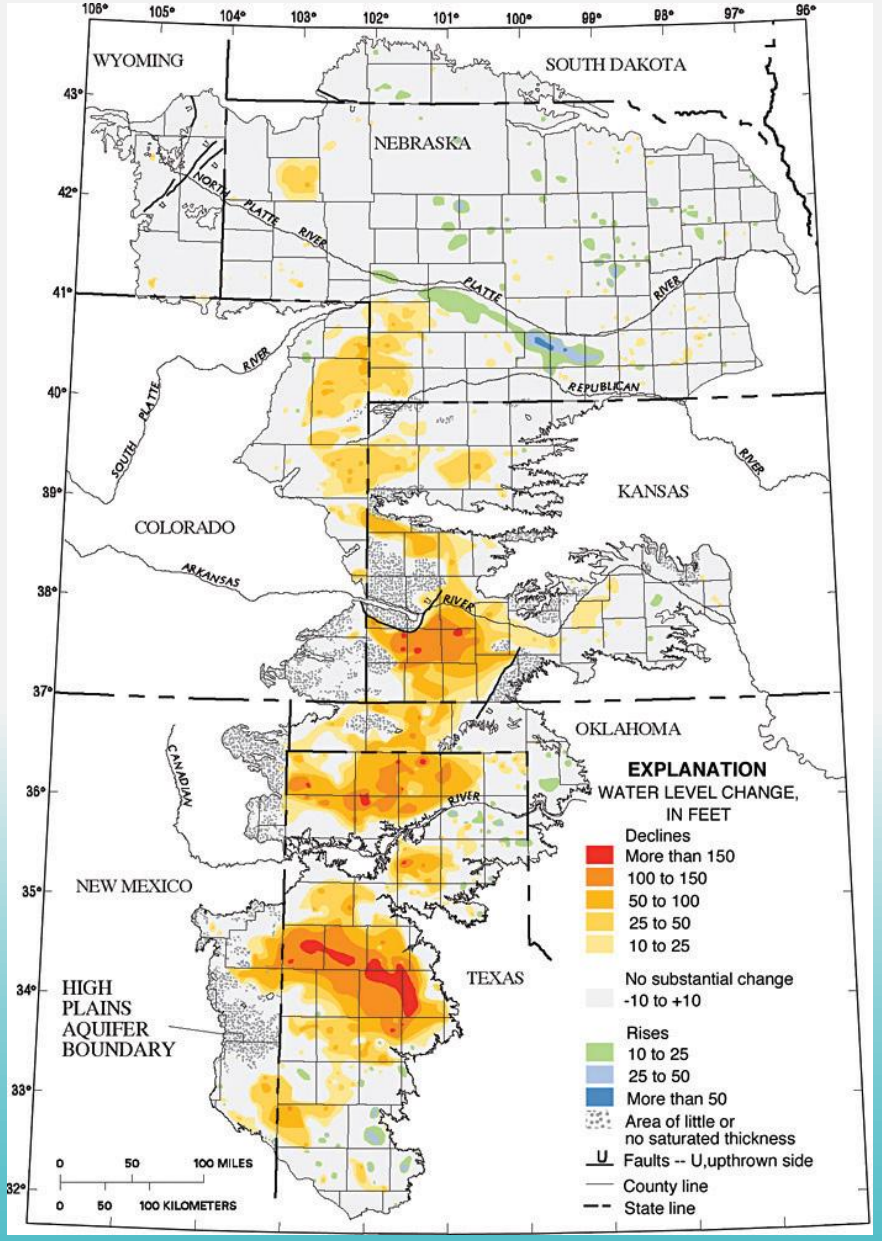
State policy for investment

- Florida Water Protection and Sustainability Program in 2005 provided for state support for development of alternative water supplies to meet projected 2025 water demands throughout Florida
- As a result, FL districts can meet 2025 demand
  - Reclaimed water and brackish water demineralization are the dominant sources (77%) of new water supplies

High Plains Aquifer

"Lying in a semiarid environment and geologically cut off from replenishment by sources outside the region, natural recharge of the High Plains Aquifer is meager." (p. 14)

"Beneath the eight-state region, the volume of water…is nine times the volume of Lake Erie." (p.15)



State Policy Example: Nebraska

- 2004 legislation directed the NE Dept. of Natural Resources (DNR) to complete regional hydrological examinations to determine if river basins or streams were fully or overappropriated
- Director declared several areas fully appropriated. In those locations, stream flow diversions, reservoir impoundments, and construction of additional large-capacity wells are prohibited until Integrated Management Plans prepared by DNR are completed

Conclusions related to High Plains overdraft

- It is expected that overdraft will continue in many parts of the High Plains Aquifer
- High Plains section of the paper concludes that in most High Plains locations "…no utility would be gained from leaving water in the ground. Pumping the ground water has and will continue to create wealth…" (p.17)

Research is needed to inform current policy & decision making challenges associated with increasing and competing demands for water and reduced agricultural acreage in the United States

Collaborative, interdisciplinary analyses of impacts/tradeoffs associated with alternative actions or inaction

- Reversible or not
- U.S. trade balance
- Food security
- Irrigation and urban water use efficiency
- Water reuse practices
- Expansion of surface water or groundwater storage
- Water pricing
- Conservation BMPs, etc…

Is the water management glass half full or half empty?

There are many issues to be worked on and many people working on them!

Representatives of the sectors need to talk to each other

Water Management Issues and Challenges

- Drought, Climate Change
- Growth and the need for additional supplies
- Water and Energy
- Water management outside the Active Management Areas (AMAs), including water quantity assessments
- Water Quality
- Use of effluent for potable and other water needs – the next major new water source
- Access to and utilization of renewable supplies
- Transboundary water issues
- The surface water/groundwater interface
- Riparian areas and other environmental considerations related to water
- Outstanding Indian water rights settlements
- Conservation Programs
- Recovery of Stored Water
- Approaches to replenishment
- Water cost/pricing
- Water Planning

Uncertainty!

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