Science and Water Availability

USGS Presentation

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OAS National Focal Points Meeting

August 11, 2007
Water Resources Policy is about:

- Law
- Economics
- Environment
- Investments
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True: but to be effective it must be informed by and include Science and Technology
Role of science and technology?

To obtain maximum economic benefit from our water resources, while respecting environmental values, we need:

Technologies that help enhance supply and use resources efficiently

Scientific knowledge and tools to inform public and private decisions
4 science & technology issues that are critical to water availability

Water for ecosystem services
Ground water storage depletion
Climate change and water storage
Supply enhancing technologies
What do we know about off-stream water use?
Water withdrawals by category

- Livestock: Less than 1 percent
- Domestic: Less than 1 percent
- Public Supply: 11 percent
- Thermoelectric power: 48 percent
- Mining: Less than 1 percent
- Aquaculture: Less than 1 percent
- Industrial: 5 percent
- Irrigation: 34 percent

USGS
3 key facts about off-stream water use

• Water use remains stable despite population growth

• Chief water uses for the U.S. are power generation and agriculture: both have been stable for 20 years

• Personal water use is rising, but not faster than population growth
What about instream use “Ecosystem Services” ??
The Demand for Ecosystem Services is a Major Driver of the Changes in Water Allocations
Figure 2-9.—Median mean daily flow in the Platte River at Duncan, Nebraska, in 1895-1909 versus 1975-1998. (Source: U.S. Geological Survey gauge data.)
The biota now has a place at the negotiating “table”

The difficulty in agreeing on what the biota need results in ill-defined property rights, harming all interests
• When the systems were designed the question was:
  • How much water can we reliably withdraw from the river?

• Today’s question is:
  • How much water do we need to leave in the river?

Science was needed then and is needed now
Role of Science: Evaluation of Ecosystem Requirements

- **Old paradigm**
  - Minimum flow
  - Static channel
  - Surface water
  - Single species

- **New paradigm**
  - Whole hydrograph
  - Dynamic channel
  - *And* ground water
  - Community

Lack of answers leads to **Gridlock**
The “pie” might be shrinking because ground water in storage is being depleted

Depletion impacts:
- Wells
- Streamflow
- Riparian vegetation
- Subsidence
- Water quality
- Future generations
Ground water is vital to surface-water systems.
Influence of pumping on streamflow
Streamflow depletion due to ground water development

Example: Beaver River near Guymon, OK
Ground-water development leads to changes in riparian vegetation

Santa Cruz River looking south from Tucson, 1942

Santa Cruz River looking south from Tucson, 1989
Lake or wetland impacts
An example from a Florida lake: before and after ground-water development
Scientific need: basin-scale coupled ground-water / surface-water models
Ground Water – Surface Water Interactions

- **Old paradigm**
  - Tens of meters
  - Hours to weeks
  - Withdrawal issues

- **New paradigm**
  - Tens of kilometers
  - Months to centuries
  - and ecosystem issues

Effective water markets depend on laws that are based on the proper representation of these interactions.
The “pie” might be shrinking because climate warming leads to less snow-pack storage.

Reliable supplies depend on storage:
- Ground water
- Soil water
- Reservoirs
- Snow pack
Western runoff is earlier.

Trends in center of mass of runoff.
In parts of New England, February daily streamflow has increased over the past 100 years.

Narraguagus River, Maine

All trends highly significant (p < 0.01)
While May daily streamflow has decreased.

Narraguagus River, Maine

All trends highly significant.

\( p < 0.01 \)
And yet: mean annual streamflow shows

**No Trend!!!**
Understanding snow pack dynamics and climate is crucial to water planning in many areas. This requires long data sets on precipitation, snow pack and streamflow.
The “pie” might be able to grow if technology provides for an enhanced supply

aquifer storage & recovery
water reuse
desalinization
phreatophyte control
water use technologies
There are science issues related to these technologies:

- Geochemistry
- Hydraulics
- Botany and biophysics
- Microbiology
- Wastewater contaminants (transport, reaction, effects)
- Brine disposal (trace elements)
Science and Technology provides the basis for effective management in the face of increasing competition

- Science provides the context: status and trends of the resource
- Technology can enhance supplies and efficiency of use
- Science can provide the basis for smarter decisions through prediction of outcomes (hours to generations into the future)
At the request of Congress the USGS has initiated a pilot effort to test concepts for a National Assessment of Water Availability and Use.
New report from the Subcommittee on Water Availability and Quality:

Committee on Environment and Natural Resources

National Science and Technology Council

November 2004
“The health of the American people and the economic growth of the Nation depend on continuing availability of clean fresh water.”

“The report provides the first step in the development of a coordinated plan ...”

John H. Marburger III
Director, OSTP

water.usgs.gov/owq/swaq.pdf
Does the United States have enough water?

“We do not know.”
“National water availability and use has not been comprehensively assessed in 25 years.” GAO, 2003
The NSTC report points to needs for:

• Data that define the available resource
• Understanding surface water - ground water
• Defining ecosystem water needs
• Defining water use, and the factors that influence water use
• Technology for conservation, use of impaired waters, and extending the life of infrastructure
• Understanding the variability and improve predictions of our water resources.
Water science and technology strategic planning
charge to:

National Science and Technology Council
Committee on Environment and Natural Resources
Subcommittee on Water Availability and Quality

John H. Marburger, III
Director, Office of Science and Technology Policy

Joshua B. Bolten,
Director, Office of Management and Budget

August 12, 2004
“The ability to measure, monitor, and forecast the US and global supplies of fresh water is another high-priority concern. Agencies, through the NSTC, should develop a coordinated, multi-year plan to improve research to understand the processes that control water availability and quality, and to collect and make available the data needed to ensure an adequate water supply for the Nation’s future.” –
The Subcommittee on Water Availability and Quality will build on existing research agendas, such as recent work of the Water Science and Technology Board of the National Research Council, and work of other groups such as this Water Policy Forum.