TODAY'S TECHNOLOGY PROTECTING TOMORROW'S GROUND WATER

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Technology: A Bridge To The Middle Ground Of Ground Water Sustainability

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Background

World population two thousand years ago was 3% of the present total. Now in excess of 6 billion, human population is increasing by 150 people per minute. The US and other countries are ever more crowded and consuming with rising demands and expectations for land, energy, materials, goods and services - especially water. Ground water plays a highly significant role in the economy and ecology of the United States. Water is big business. There are over 150 million Americans supplied from ground water as their drinking source and many industries, such as agribusiness, are very dependent on major aquifers. High-tech capabilities have been developed that help promote exploration and resource development and those very same technologies can be applied to assist endeavors that focus on ground water protection and conservation and on management strategies that may achieve sustainability.

Introduction

The title of the paper, Technology: A Bridge To The Middle Ground Of Ground Water Sustainability contains deliberately selected words. The use of "bridge" in the title connotes a convenient way of moving between places, or positions (science and management). The words "middle ground" indicate some form of compromise between competing demands or ideas (unfettered use and controlled use). The keyword "sustainability" is at the heart of many of the current endeavors in hydrology that seek to achieve a balance of resource use. Implicit in the word sustainability is an economic and social element that has defined a level of water use. In defining sustainability there is therefore a need to first determine a level of use.

Considerations of sustainability move beyond hydrology and encompass economics and political decisions. Because water is a renewable resource, sustainability is a logical basis for ground water management and protection policy. In reality, ground water policy may be more of a hybrid artifact that occurs as a by-product of other policies developed for areas such as public health, endangered species or agriculture. Cutting edge techniques in science now share technology to achieve an integration of research, application, and public policy.

The importance of finding technical solutions to providing reliable and safe water supply for homes and communities is matched by the equally important focus of developing overall water management strategies for resource protection. Regional resource management, water allocation and long term water resources planning is an increasingly politicized process. For technically oriented management strategies such as conjunctive use of surface and subsurface resources, knowledge and understanding about ground water by non-specialists will become even more important to achieve socially equable and hydrologically sustainable water policies.

Technology and Sustainability

When resource sustainability is a desired outcome, then technology and the applications of technology can provide a communications link between the scientific/ engineering specialists and community decision-makers. The achievement of a basic understanding of science by decision-makers is a critical requirement for the successful transition from awareness to concern, and from concern to action. Local managers and concerned communities can make use of technologies that provide data, enhance understanding of problems and allow for greater sophistication in solutions. With an education-link to science and technology there can be access to information to support protection initiatives and provide informed input to laws, codes and zoning regulations that protect ground water integrity, public health and the environment

The management paradigm of sustainability is likely to grow in importance as a basis for water resources decisions. To be effective, it will require recognition of the important roles and values of science. The "Dublin Principles" established by the International Conference on Water and the Environment in January 1992 recognized that water resources are finite and vulnerable and that sustainability should be a management objective for water policy. Sustainability with respect to water management involves using water in a way that can support human needs for the long-term without jeopardizing ecosystems or the hydrologic system. Greater awareness and concern about ground water management and protection result from:

- increasing human populations,
- greater water demands (domestic supply, industry and agriculture),
- stressed and contaminated hydrologic and ecological systems, and
- finite levels of water availability.

Figure 1 serves to illustrate some of the interrelated components related to technology and ground water sustainability. In the following paragraphs each is discussed.

Who needs the Water?

A first step is to find out who owns the water and who needs it.. The water rights issue will become more and more an ingredient of management issues. Does water belong to landowners or to a local or state jurisdiction? If local jurisdictions, citizens, communities and landowners cannot cooperate to achieve workable water management decisions then the courts will become the principal instruments of water policy. Water management strategies to achieve resource protection will increasingly require the support of a range of constituencies from within and beyond the communities and regions they affect.

The whole concept of resource management requires an objective assessment of all potential beneficial users in addition to current users. Federal and state agencies, citizens groups, private sector interests and environmental organizations all have a role to play in decision-making. The input from a range of technical experts can help ensure that management decisions are not biased towards a particular agenda.

Overuse

With an additional 100 million population predicted in United States by 2050, water management paradigms have changed from:

How much water is needed and where do we get it? to

How much is there and how can it best be used?

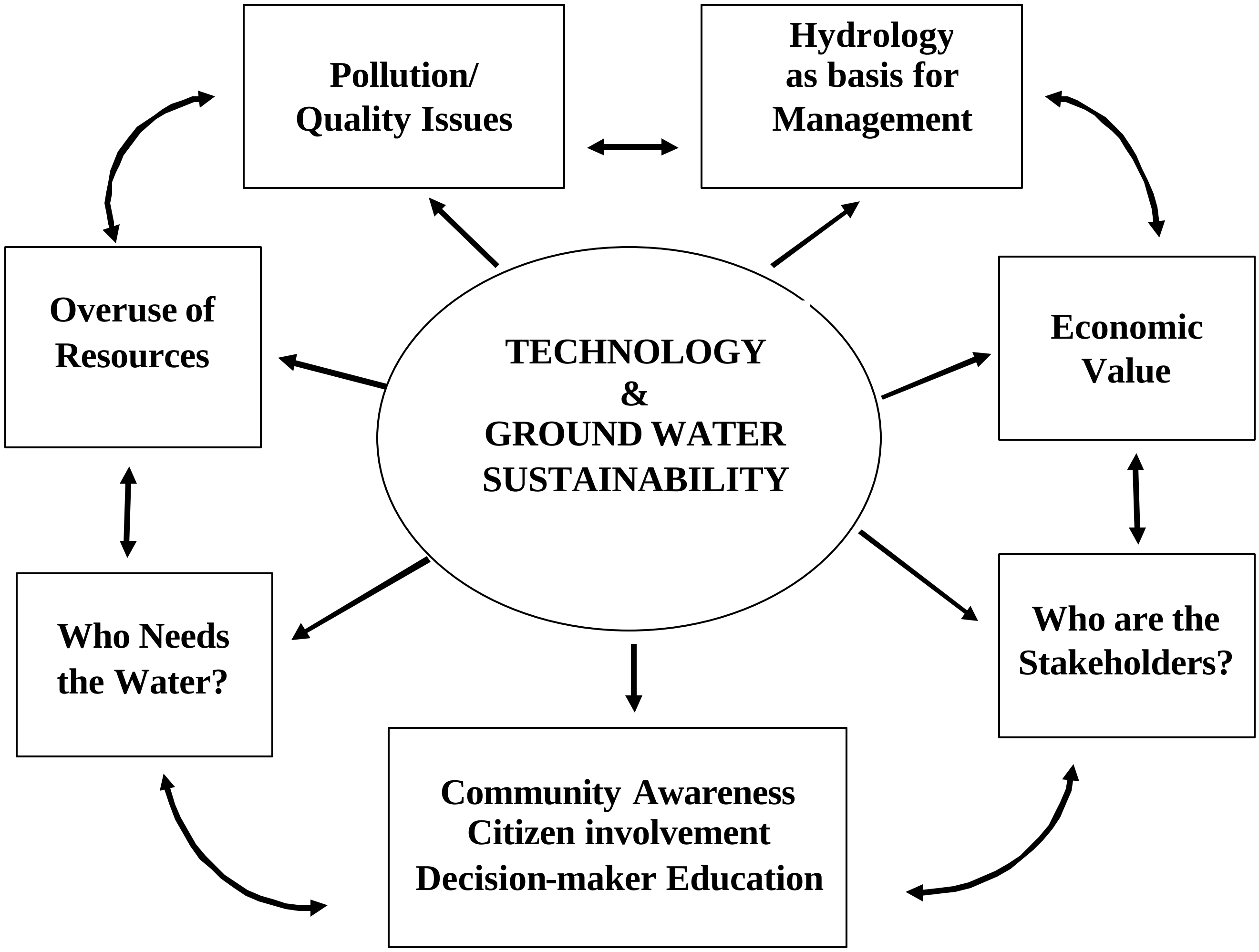

Figure 1
Technology: A Bridge To The Middle Ground Of Ground Water Sustainability

In virtually every state, large and small aquifers are under stress from overuse. We value the water when the well is dry, or, as an economic principle, scarcity adds value, and therefore gets attention. While we may have the technical and engineering capability to move water from almost anywhere to almost anywhere else, engineering feasibility is likely to take second place to jurisdictional and environmental pressures for "control" of water management decisions. If it is the "people" who will be influencing water policy decisions there is an ever-growing challenge to help decision-makers understand the issues. The principal water management challenge at local and regional levels is to achieve water policy based on sustainability.

Pollution and Quality Concerns

State by state, there is a sad litany of instances of ground water resources being degraded by contamination. Technology has done much to help define and characterize polluted aquifers and in some instances, technology is helping with remediation. Ever increasing requirements for water are exacerbated by the loss of resources through overuse and contamination. Increasing water supply availability leads to increased water use. Education is especially relevant in areas where individual behavior can have an impact. Teaching environmentally friendly and socially desirable waste disposal habits can compliment water infrastructure improvements.

In upstate New York, some 50 communities are in a voluntary watershed protection partnership to help protect water quality. The alternative to watershed responsibility is some $8 billion in federally mandated water filtration costs for the City of New York. The original computer models derived for engineering purposes have a powerful education ingredient when integrated with economic data. The science of hydrology cannot be an ivory tower abstraction. Real problems needing solutions require that our ivory towers serve as lighthouses to illuminate community management decisions.

Economic Value

The value of water should include environmental/ecological values in addition to the direct benefits derived by private sector enterprise and/or the local, regional and national economy. Follow the money, "cui bonuo" is an important part of the calculus of resource protection and management for sustainability. There are some key questions: Who is profiting from the current use of water? What is the value of water if used for some other purpose. Will a particular water management decision benefit one group more than another? Carving up the water pie presupposes that someone knows the size of the pie? Mother Nature may unpredictably provide annual water pies of different sizes.

Water policy has to address more than the short term economic benefits that accrue to the direct user and if the policy includes built-in over-exploitation, then the social costs of non-sustainability must also be factored into the water policy. The price of the "exit strategy" from a water-related development should be borne up-front by the beneficiaries.

Hydrology as Basis for Management

There is a strong reason to consider all water, surface water or sub-surface water as a single resource. There may be strong jurisdictional precedent for separate management strategies but it is likely that an integrated approach will become even more prevalent. Modern data collection and manipulation capabilities have helped move management paradigms towards a watershed approach. Applying old command and control water management templates to new water resources issues is not likely to solve today's growing water resource problems. Much policy that relates to ground water is a by-product of other policies.

As the watershed approach to management becomes more established and more data are shared there will hopefully be less "turf wars" among overlapping jurisdictions. In the integrated resource concept, one person's down-stream is another person's up-stream; one community's wastewater is another community's source water and today's ground water is tomorrow's river base flow.

Who are the Stakeholders?

Stakeholder groups may have an interest in being involved with water management or water policy decisions. Water is increasingly perceived as a shared resource. Policies with public support are more likely to work. However, in order for citizens to be meaningfully involved in the process they must have an informed awareness of the issues. Technology provides an opportunity to serve as a bridge between the scientists and the community. Most citizens are interested in long-term solutions and there appears to be a slow but ever growing public acceptance of the concept of resource sustainability as a reasonable management objective.

Transfer of understanding about resources from specialists to decision-makers and the communities they serve can help keep citizens connected to the resource base and so fuel the natural synergism between people and places.

Public Education/ Decision makers

It is important to identify the different roles of scientists and decision-makers. It is the role of Politicians to decide policy, and in the process, they are expected to consult experts and invite public participation. Ground Water Scientists have to "sell" their science to the public and serve as a link between science and decision-making. An example of technology assisting decisions is found with the increasing use of 3D models in the courtroom and in public hearings.

Sophisticated software improves our ability to organize, visualize and evaluate information, and portray alternative ways to represent data. Non specialists can readily appreciate visualization. Hydrologic simulation models, even using off-the-shelf software applications, can be used to educate stakeholders by demonstrating subsurface flow concepts. Such information can serve to explain the issues and illustrate the technical options.

Conclusion

Today's resource protection challenges are the nexus of science, policy and management. Most decisions involve complex interactions, as illustrated in Figure 1. The decision-making process needs to be cognizant of the potential effects. Cause and effect are not usually isolated, nor can they be constrained in simple time frames. Technology has the power to bring information to the public. For example, the results of water quality tests can be almost instant, and telemetry allows for real-time data acquisition of water levels in wells or rivers that can be downloaded from the Internet. Many of these data, such as US Geological Survey information are available to the public. Data collection and communication technology is illuminating what was formerly the "black-box' domain of the scientist.

The rising tide of decision maker and community awareness has been greatly aided by technology. The information and communication explosion has provided a platform to integrate social and economic criteria into formerly purely hydrological endeavors. Science is more open and scientists increasingly recognize the need to relate their work to solutions. There has to be a middle ground because of the ecological and economic demands on resources. The equable distribution of water in water-scarce areas such as southern California poses real public education challenges.

Politicians will make the decisions, and politicians are influenced by public opinion. Technology will help to keep the public informed about the basis for water management recommendations. Hopefully there will be informed decisions based on objective science, and hopefully too, the rising tide in ground water awareness for protection and sustainability will also serve to raise the boats of public health, quality of life, economic well being and environmental sustainability.

end

References

(Some ideas and information in the paper were drawn from the sources listed below)

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