American Water Resources Association
2007 ANNUAL WATER RESOURCES CONFERENCE
November 12, 2007 – November 15, 2007

Monday, November 12
1:30 PM – 3:00 PM
SESSION 6: Water Markets II

1. Meeting Water Demand by Controlling Groundwater Extraction and Recharge: A Hybrid Model in Developing Country - Bishwa Koirala, The University of New Mexico, Albuquerque, NM (co-author: Steven J Archambault)

Meeting Water Demand by Controlling Groundwater Extraction and Recharge: A Hybrid Model in Developing Country An analysis of water demand and supply in Kathmandu metro politician city with a population of 1.7 million is carried out. A water supply comprising of available surface water and groundwater is not enough to meet the ever-increasing water demands of Kathamndu city. Further, extraction of groundwater at rates faster than the natural aquifer recharge may cause severe environmental consequences. The wet season stream flows are more than sufficient to meet the urban water demands of Kathmandu city. There is an opportunity for Kathmandu city to store the excess supply from the wet season underground, so that it is available for future use. Missing this opportunity may cause the city to suffer stark drinking water shortages. To illustrate this opportunity, a dynamic model has been developed. The model optimizes groundwater recharge and extraction rates, addressing the present water shortage problem of Kathmandu city. The study simulates a hybrid model and identifies the impact of recharge on the level of aquifer, along with its effect on groundwater pumping. This modeling approach aims at demonstrating the optimal quantity of extraction and recharge over time to maximize social welfare. This welfare consists of water consumption, and the costs associated with pumping and injecting water into the aquifer. This is a hybrid model considering the dynamic hydrologic conditions such as rates of recharge, storability of the aquifer, evapotranspiration, and the effect these natural conditions have on the economic decisions to pump groundwater, and recharge surplus water into the aquifer. The model gives policy makers insight into how different management strategies will impact the short, medium, and long range supply of water resources. The model identifies the most sustainable approaches for using wet season surplus flows to recharge the groundwater for meeting the water demand of Kathmandu city for at least 300 years.

2. Filling the Data Gap: Experimental Results in Urban Water Consumer Response to Price Changes - Kate Krause, University of New Mexico, Albuquerque, NM (co-authors: Janie M. Chermak, David Brookshire, Steve Stewart)

Uncertainty over the adequacy of water resources in semi-arid regions has led to increased interest in conservation policies. The success of such policies will be determined, in large part, by the accuracy of the analytic tools used for policy assessment. Vital components of these tools will be economic models that include accurate demand and supply components. This research focuses solely on the demand-side. While existing research efforts have empirically modeled the demand for water, in most cases water prices in the historical data occur within an extremely limited range that reflects neither the full cost of the water nor the increased scarcity of water in many semi-arid regions. The difficulty with policy prescriptions that rely on price as a rationing mechanism is that, without adequate data to gauge consumer response, there can be substantial uncertainty in policy outcome. Experimental economics is one way in which data and, thus policy, can be augmented. Previous research (Chermak, Krause, Brookshire and Burness 2006) shows that economic experiments can elicit accurate responses from urban water consumers. 70% of participants' experimental responses to changes in the price of water (within the actual price ranges) were statistically consistent with their actual market response. Thus, there is the potential for experimental results to augment available data. We extend the original research to prices well outside the current range to prices that are more realistic for future conservation pricing structures. Experimental participants from Albuquerque participate in an experiment that elicits their response to changes in price. The design allows us to observe the sensitivity of specific water uses to price changes, information that will be valuable in designing targeted incentive policies. This allows us to test not only aggregate demand response to price changes and the subsequent impact on water use, but also for heterogeneity of consumer response.

3. Integrated Modeling to Test And Design Alternative Water Markets: Rio Mimbres, New Mexico - Alison Williams, Sandia National Laboratories, Albuquerque, NM (co-authors: Vincent Tidwell, Will Cain, David Brookshire, Craig Broadbent, Don Coursey)

Large portions of the United States have been experiencing water shortages in recent years, resulting in high tensions and potential for conflicts. One such area is the Upper Rio Mimbres, in southwestern New Mexico. In 2005, the New Mexico Office of the State Engineer created the Upper Mimbres Water Master District to "ensure the economical and satisfactory apportionment of water…and the public safety of water users …and protection of existing water rights … from impairment" (Order No. 171). Accordingly, the OSE is interested in the possibility of water leasing to help ease the effects of, or prevent, a priority call in the basin (which would shut off all domestic wells except for essential indoor uses and all junior ditches, which in this case are upstream of the senior ditch). In an effort to develop a prototype water market, we have developed a system-dynamics based hydrologic model of the basin using historical data from 1950-2006 coupled with a double oral auction specialist user interface for short-term leases. Leases change ditch diversions in the hydrologic model, and appropriate hydrologic information is sent back to the market model to inform future leases. The coupled hydrologic/market model is designed to allow stakeholders and market regulators the opportunity to explore alternative market designs and market regulations, and to allow potential participants the opportunity to become comfortable with the system prior to investing real money and water. Both the hydrologic and market models have been developed with input from the OSE and users in the basin, and results of water market experiments with the model will help finalize the design of a working water market. The model can run tests of lease situations where 1) leased water can only be used during a call or 2) where leased water can be used anytime, enabling irrigators to put more than the adjudicated amount of water on their crops (stacking). Results of this effort explore both the response of stakeholders and decision makers to alternative market systems as well as an analysis of unintended consequences, both hydrologic and third-party, resulting from the operation of select market systems.

4. Using Conservation Credit Offset Trading and Groundwater Permitting in a Groundwater Scarce Watershed to Protect In-stream Ecological Service Values - Sandra Batie, Department of Agricultural Economics, Michigan State University, East Lansing , MI (co-authors: Michael D. Kaplowitz, Saichon Seedang)

Growing demand for groundwater withdrawal for urban, agricultural, and industrial development can lead to depleted groundwater. Withdrawals at rates greater than recharge can draw down water levels in nearby wells, reduce stream base flows, and adversely impact aquatic ecosystems dependant on groundwater flows (e.g., wetlands, rivers). The increased use of high capacity wells has created conflicts among water user groups and raised concerns about aquatic ecosystem protection in the Great Lakes region. Policymakers, stakeholders and others are calling for innovative approaches to sustain groundwater resources that balance the need for economic development with environmental and ecological protection. This research explores a groundwater management approach based on market-like structures-groundwater withdrawal permits and a system of marketable conservation credits. Using groundwater and other data from a watershed in southeastern Michigan, the researchers developed and evaluated the strengths and weaknesses of such a system. It was found that the proposed market-like structure (conservation credit offset trading) has many advantages when compared with other more traditional control mechanisms (e.g., restrictive regulations or prohibition). The proposed scheme appears to allow for new or expanded high value water users even in critical watershed areas especially when such users appropriately compensate existing groundwater users to reduce their withdrawals, change behavior, and make offsets available. The research outlines the policy characteristics for a conservation credit offset program intended for use with a groundwater permitting regime. The study specifies the necessary conditions for a conservation credit program to operate and provides examples of potential offsets (i.e., conservation credits) that may compensate for proposed groundwater withdrawals. The researchers developed a hypothetical permit system, a regime for conservation credit offsets, and tested alternative scenarios for a critical watershed using groundwater, land use, and hydrological modeling. The research demonstrates the importance of modeling for evaluating impacts of alternative pumping and policy scenarios as well as understanding the effectiveness of various conservation credit offsets on groundwater levels, stream base flows, surface water levels, and ecological impacts. The research demonstrates that a conservation credit trading approach and permit system may provide a cost-effective method for balancing groundwater use and ecological protection.