

# INCENTIVES AND TRADING IN WATER RESOURCE MANAGEMENT

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## INTRODUCTION

Most of the emphasis in water resources policy during the first seventy years of the twentieth century was on development of new supplies. As we approach the twenty first century the emphasis has shifted to the improved use of existing resources and reduction of environmental side effects of water resources. This change in policy emphasis has raised the importance of institutions and mechanisms that promote efficient use of resources and improved allocation. Thus, we are going through a gradual process of introduction of markets and trading for water resource management. This transition is occurring globally but varies according to the specific environmental and historical peculiarities of various locations.

This volume presents papers that provide an overview of changes in water resource management strategies in various locations. They mostly take an economic perspective to analyze the causes and impacts of introducing markets and trading, to investigate some of the obstacles for use of economic incentive for water resource management, and consider some of the limitations of economic tools.

These studies also present a variety of methodological approaches. For example, in Articles 8 and 11 there are applications of option theory to resource management problems, while in Article 12 an empirical modeling approach is presented. The first seven papers present problems in the United States (U.S.). They are followed by water problems from Holland, India, France, and Israel. Taken together the papers provide a broad overview and integrated perspective on water resource issues today.

Traditionally, in many parts of the world there have been restrictions on trading through the application of water rights regimes; but in Article 2 Brozovic et al. show, by using evidence in California, that trading occurs even under restriction. They observed establishment of permanent relationships between small groups of water users (frequently in pairs) that tend to trade mostly among themselves. This tendency to a steady relationship may be explained by the high cost of conveyance and the difficulty of water resources routing.

In Article 3, Zilberman et al. use another case from California to show that extreme conditions, in their case drought, trigger modification in water resource management. The drought of 1987-1989 led to the adoption of conservation and the introduction of trading in California. In Article 4, Gisser shows that the same concept of "prior appropriation system" that may have prevented trading in California was applied in New Mexico to enable water trading. He argues that the New Mexico system, with strong technical monitoring, led to efficient water resource allocation of both surface and ground water.

Unlike New Mexico, Texas (like California) has restriction of water trading. The Griffin and Characklis report in Article 5 states that Texas has four different water doctrines that applies to ground or surface water. Initiated by judicial action, but without much legislative support, increased scarcity sparked interest in pro-marketing changes. They expect to see a more centralized control of ground water that will lead to efficiency and increase trading within basins. But this process of transition will take time.

Increased scarcity that would lead to trading, market and higher prices is likely to trigger changes in the way water is applied. In Article 6, Osgood provides evidence in California to show that economic incentives play a major role in leading to adoption of weather information (supplied through California Irrigation Information System). Regions with high water prices and producers of high value crop are the major adopters of this technology. This adoption, in many cases, increased likelihood of increased adoption of drip irrigation. Thus, increased scarcity leads to increased use of information and in turn that supports water conservation technology.

The first 6 articles show the importance of economics in the understanding and designing of new institutions of water allocation, but there is still a need for water projects that will address environmental problems or certain risks. One of the biggest challenges is to provide the institutional design for a project that addresses transboundary water problems. In Article 7, Frisvold and Osgood demonstrate the severe difficulty in solving wastewater collection and treatment on the U.S./Mexico border. They show that new institutions that were established to address environmental concerns

over the North American Free Trade Agreement (NAFTA), helped to finance some of the water treatment problems; but they are financed by federal agencies, rather than locally, and that this may hamper their sustainability. They suggest that developing mechanisms for local finance of water quality enhancing facilities is a major research and policy challenge.

In Article 8, Zhao suggests that the real option approach should be adopted to analyze the design and economics of water projects. This approach enables addressing problems of irreversibility and uncertainty about environmental damage and thus, may improve our capacity both to determine timing and magnitude of new projects. He adopted this approach to provide a new strategy for the American River Watershed project.

Hellegers and van Ierland in Article 9 provide an example from Holland where existing water rights systems impair the adoption of modern irrigation technologies and increasing ground water use efficiency. The current regime results in low value use of ground water and cause desiccation. They suggest a more diversified set of policies that includes ground water pricing reform, transferable rights, fine-tuned bans, persuasion and subsidies, all of which would lead to increased efficiency and improved environmental quality. Ray and Williams in Article 10 suggest emphasizing the importance of locational consideration in water resource management in their analysis of the water system in India. Upstream farmers have a locational advantage and the modeling outcome of allocation rule have to take into account possibilities of unofficial diversion without effective monitoring. They suggest mechanisms for regional cooperation, which

would lead to better enforcement of the allocation rule and increase efficiency of water systems.

While insufficient control of conveyance is the reason for the misallocation of water resources in rural areas, the municipal problem may be monopolization. In Article 11 Clark and Mondello develop a framework to analyze and regulate a natural monopoly that provides surface water. The optimal pricing that they develop takes into account the liability for the irreversible and environmental damage that water provision may entail. They argue that concern for environmental issues and liability laws should lead to modification of existing water utility pricing.

Most of the articles in the book emphasize the importance of pricing incentives in modifying behavior; but in the last article Heiman demonstrates, by using empirical studies from Israel, that education and increased awareness may also lead to water conservation. He argues that consumers are to a certain degree careless in their water use and they could easily modify their consumption in response to higher prices or a sense of societal urgency. Therefore, policy makers may consider integrating pricing with educational effort in addressing water scarcity.

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