Exploring the Feasibility of Transferable Discharge Permits for Water Quality Management

Project Progress Report

Keith D. Willett
Department of Economics

Ramesh Sharda
Department of Management

Joseph Westphal
Department of Political Sciences

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Introduction

In recent years, environmental policy has become an increasingly important part of government regulatory activities. This, in turn, has motivated questions concerning the effectiveness of these activities. In particular, these questions are concerned with the cost effectiveness of regulatory activities as well as the ability to bring dischargers into compliance with water quality standards.

The use of economic incentives for achieving water quality standards has drawn a great deal of support from economists. The exact specification of economic incentives can take many different forms, but more recent analytical attention has been focused on the use of transferable discharge permits (TDPs) for achieving water quality objectives. Tietenberg (1980) has noted several reasons for this. First, a TDP system would be used to replace the current purely regulatory system with the potential benefit of achieving a higher level of water quality than with the current approach at a substantially reduced commitment of resources to pollution abatement. Secondly, a TDP system provides polluters with incentives to adopt pollution control technologies which provide greater levels of pollution abatement at a lower resource cost since inventories of excess pollution rights permits can be sold. This, of course, provides an economic incentive for developing new pollution abatement control techniques. The objective of this project was to determine the feasibility of a TDP system for water quality management in Oklahoma.

Methodology

A number of methods are available that could be used to evaluate the effectiveness of TDP's. David et al. (1980), Eheart et al. (1980), O'Neil (1983), and O'Neil, et al. (1983), for example, have used mathematical programming models to evaluate the effectiveness of TDP's. However, it could be argued that behavior cannot be predicted in a deterministic way, which seems to be the premise of mathematical programming models. That is, optimization models presuppose some form of rational behavior on the part of managers such as profit maximization or cost minimization. A viable alternative to mathematical programming models for assessing the effectiveness of TDP's is simulation gaming or experimental economics. Experimental economics has been utilized in various phases of economic research (see, for example, Hoggatt et al. (1976), Smith (1976), Smith et al. (1982) and McInish (1981)), Freejohn and Noll (1976), Miller, et al. (1977)). Weber (1974) has noted that experimental economics or simulation gaming is different than other forms of economic analysis because an attempt is made to establish a controlled situation in which ". . .subjects are asked to participate by making the remainder constant. Behavior of the subjects with respect to the simulated situation can be observed as some elements are changed" (Weber, 1974, p. 3).

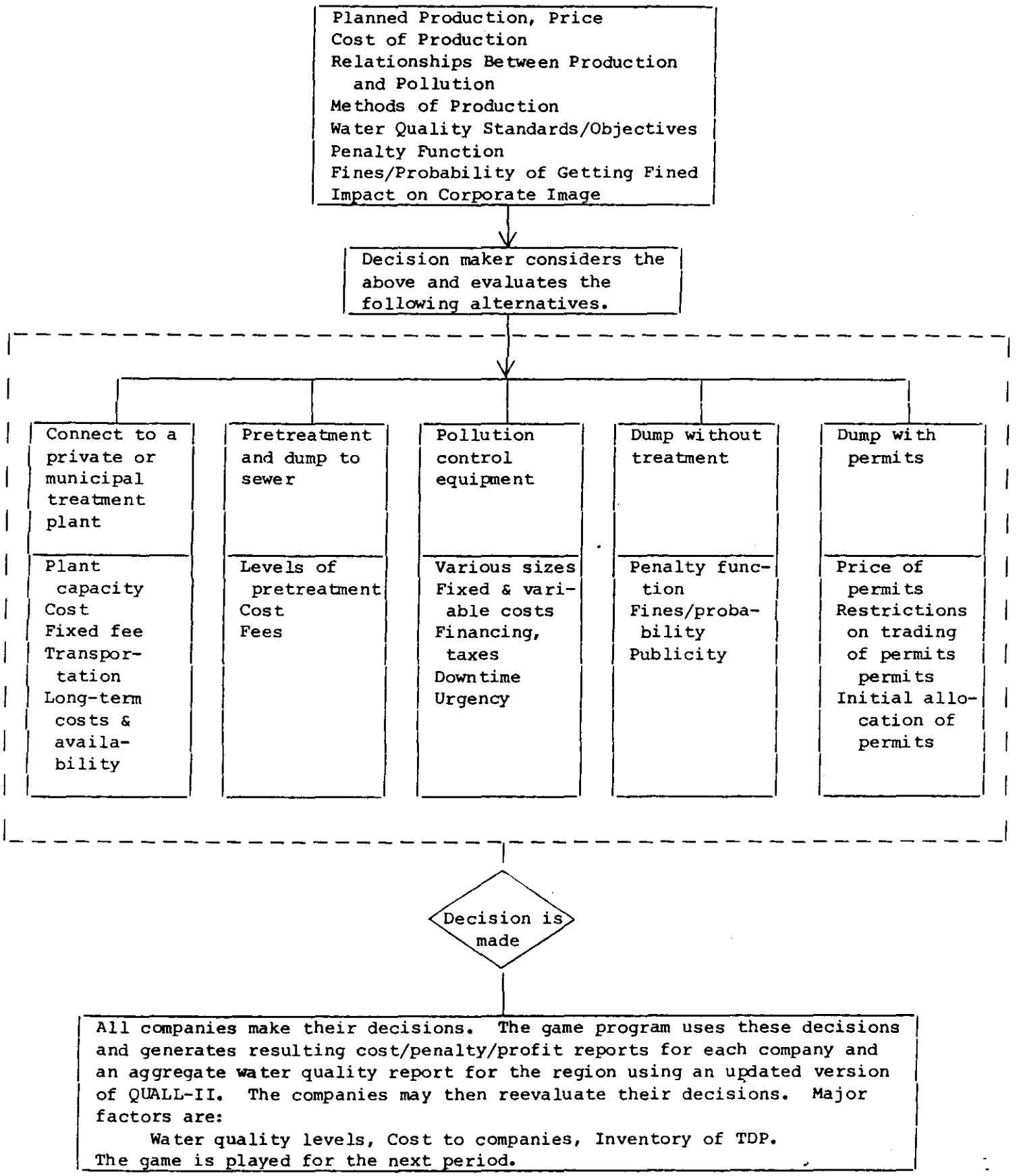
Simulation gaming has been employed as a tool for training and research in water resources management. Wright and Howell (1975) describe a simulation game for water resources development in New South Wales. Palmer et al. (1979) reported that PRISM, a game developed by them, was valuable in identifying issues of water supply management to decision-makers at various agencies in the Potomac River basin. Diamond et al. (1984) discuss the design of a simulation game to teach and research issues in drought management. Our

limited literature search has uncovered no games designed for water quality management decisions, especially from the participating firms' viewpoint. Such a game would be valuable in not only teaching aspects of water quality decisions, but it could also be used as a research tool in understanding economic issues of water quality management.

Initial work for this project was funded by Oklahoma State University's Water Research Center. So far, we have been interviewing managers as well as regulators to identify relevant data. The objective has been to make the game as realistic as possible. We have consulted many faculty members in environmental engineering. We also have contacted the Oklahoma State Water Resources Board and the Association of Central Oklahoma Governments. Both agencies have shown enthusiasm for the project and provided historical data. Our data collection so far has been to determine the realistic numbers we specify for each participant. We are now developing the case scenarios for each participant.

The basic structure of the water quality management game is shown in Figure 1.

Figure 1: WATER QUALITY MANAGEMENT GAME



List of Publications

1. Sharda, R., "Linear Programming on Microcomputers: A Survey," Interfaces, Vol. 14, No. 6, pp. 27-43, 1984.

2. Sharda, R. and C. Somarajan, "Comparative Performance of Some Microcomputer LP Systems," Computers and Operations Research, forthcoming, 1985.

3. Sharda, R., "A Summary of OR/MS Software on Microcomputers," under review at Operations Research.

4. Willett, K. D. and R. Sharda, "A Dynamic General Equilibrium Model for Analysis of Pollution Control Policies," under review at Natural Resources Modeling.

5. Willett, K. D., "Environmental Management Costs Using a Best Available Control Technology (BACT) in the Electrical Generating Industry," Managerial and Decision Economics, forthcoming, 1985.

6. Willett, K. D., "The Nature of Net Benefit Functions, Discounting and the Length of Optimal Time Horizon for Extracting Nonreplenishable Resources," Energy Economics, July 1985.

7. Willett, K. D. and J. S. Shortle, "Regional Markets for Transferable Discharge Permits: A Multi-Market Equilibrium Model," Working Paper No. 84-22, Office of Business and Economic Research, Oklahoma State University, 1984.

List of Presentations

1. Sharda, R., "Validation of Monte Carlo Simulation Features of IFPS," National ORSA/TIMS meeting, Dallas, TX, Nov. 1984.
2. Sharda, R. and E. Wasil, "Status of Mathematical Programming Software," Special ORSA Conference on Microcomputers, Denver, CO, March 1985.
3. Willett, K. D. and J. S. Shortle, "A General Equilibrium Model for Calculating the Economic Impacts of a Federal Water Pollution Control Program," Eastern Economics Association meetings, Pittsburgh, PA, March 1985.

Graduate Training

The funding for the project has helped train two graduate students. One of the students, Mr. Shin-An Chiang has defended his proposal for doctoral dissertation in Civil Engineering. The other student, Mr. Michael Barton is finishing his master's thesis on a decision support system for release decisions.

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