THE CLEAN WATER ACT:
AN ECONOMIST's APPRAISAL

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Introduction

The water in our lakes, rivers, and streams supports a wide range of uses. Water can be withdrawn for drinking and other domestic uses, for industrial processes, or for irrigation. It can support fish populations that are the basis of commercial exploitation and recreational fishing. It can be used for boating and swimming, and it can be used to flush away the wastes from factories and municipal sewers. Most of these uses are to varying degrees dependent on the quality of the water. Yet the use of a water body as a waste receptor can seriously degrade water quality and impair or even preclude other uses.

A Ralph Nader task force report, "Water Wasteland," published in 1971, helped to dramatize the poor state of some of our water bodies. At least in part in response to that report, Congress enacted the Federal Water Pollution Control Act of 1972. This law was revised in 1977 and again in 1987 and is now known as the Clean Water Act (CWA).

In this paper I describe the key features of the CWA, review what is known about what has actually been accomplished in controlling discharges and in improving the quality of our nation's waters, and present an economic assessment of water pollution control policy.

The Law

The law established two primary objectives. The first is the elimination of all discharges of pollutants into navigable waters by 1985. The second calls for attaining "fishable and swimmable" waters by 1983. The principal means for achieving these objectives are the establishment and enforcement of technology-based effluent standards. These standards are quantitative limits imposed on all dischargers where the quantities are based on the present technology. To put it simply, standards are set based on what can be done with available technology rather than what should be done to achieve ambient water quality standards, to balance benefits and costs, or to satisfy any other criterion. Since production processes, quantities and composition of waste loads, and treatment technologies vary substantially across industries, separate discharge standards must be developed for different industries. These standards are referred to as "effluent limitations."

Effluent limitations become the basis for discharge permits to be held by all dischargers. These permits limit the allowable discharges of the individual polluters to the quantities that are consistent with the relevant technology-based effluent limitation. Permits were initially to be issued through the regional offices of EPA. If a state agency satisfies certain conditions, however, it can take over responsibility for issuing permits and enforcing their terms.

The CWA also includes significant provisions dealing with non-point sources of pollution and providing financial assistance to municipalities for construction of municipal sewage treatment systems. But space limitations preclude any discussion of these issues.

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Accomplishments

It has been estimated that as of 1977, about 80 percent of industrial dischargers complied with their effluent limitations and that by 1981, 96 percent of these sources would be in compliance. The compliance rate for municipal dischargers was substantially lower. It has also been estimated that this level of compliance by industry would result in an approximately 65 percent reduction in industrial discharges of oxygen demanding organic material and an 80 percent reduction in suspended solids.

The term "compliance" as used by EPA generally means the installation of treatment equipment capable of meeting the effluent limitations when properly operated. These data do not say anything about actual discharges. To determine the degree of effective compliance, it is necessary to examine the discharges of polluters and to compare them with the terms of their permits and relevant effluent limitations.

The U.S. General Accounting Office (GAO) attempted to do this for an 18 month period in 1981- 82. The GAO had to rely on discharge data supplied by the dischargers rather than independent measures; thus the degree of effective compliance may be overstated. Nevertheless, the GAO study indicated a significant noncompliance problem. They examined the discharge data for about a third of all industrial and municipal dischargers in six states. Eighty-two percent of the sources had at least one month of noncompliance during the 18 month period. Moreover, about 24 percent of the sample was in "significant noncompliance" with at least four consecutive months during which dischargers exceeded permitted levels by at least 50 percent. The performance of municipal sources was poorer than that of industrial sources, and this was especially true in the case of significant noncompliance.

It is important to try to determine whether the CWA has resulted in levels of water quality across the country that are better than they would have been, other things equal, without these laws, and if so, by how much. None of the available data can answer this question conclusively; but we can draw some inferences from several sets of data. These data are of two types: predications of changes in water quality in response to changes in discharges based on water quality models that hold other things, such as the level of economic activity, constant and observations of actual changes in water quality.

Researchers at Resources for the Future (RFF) have made a major effort at modelling the effects of the 1972 law on several measures of water quality. The RFF water quality network model is based on inventories of waste generated at point sources and estimates of actual removal rates as of 1972. The inventories of wastes generated and discharged are combined with a model of pollution transportation to predict values for four water quality parameters at over 1,000 locations in the continental U.S. Estimates of increased treatment levels because of the law can be used to predict changes in discharges and, hence, water quality measures across the country.

The study examined two scenarios. The first was based on the estimated actual 1972 discharges of polluting substances and predicts the percentage of locations achieving assumed water quality standards. About 83 percent of all locations was predicted to have been meeting the standard for dissolved oxygen in 1972. Also, in this scenario relatively few locations were predicted to have attained the assumed standard for phosphorus and nitrogen.

In the second scenario, the model predicted water quality at each location assuming all point sources of pollution to be in compliance with the relevant effluent limitation. The model predicted increases in the number of locations meeting the standards for each of the four water quality parameters; but the absolute and percentage increases are surprisingly small. The model predicted only a 6 percent increase in the number of locations satisfying the dissolved oxygen standard. But this is in large part because of the high percentage of locations already meeting the standard. On the other hand for those two parameters where there is greatest room for improvement, phosphorus and nitrogen, the law has a relatively small effect on the number of locations in violation. This is because the point sources affected by the law are relatively unimportant sources of these pollutants. In summary, to the extent that this model accurately predicts water quality, it appears that the CWA has had relatively little affect on water quality in many areas.

Measures of water quality such as dissolved oxygen or total phosphorus may not have much meaning to most people. What matters most to them is how changes in such measures affect various uses of the water body. One such use of rivers and lakes is recreational fishing. To the extent that reduced pollution results in more recreation opportunities and higher quality recreation, fishermen are made better off. Researchers at RFF have developed a method for classifying water bodies by the quality of fishing opportunities they present and for translating changes in water quality as predicted by the RFF water quality network model into changes in the availability of water for various categories of fishing.

Using the estimates of actual discharges in 1972, the model predicted that only 4.2% of the waters covered by the model fell into the unfishable category in 1972. The implementation of the CWA was predicted to increase the total fishable area by only 0.35***%.*** The major benefit of the law came from improving the quality of fishing in already fishable areas.

These results from modelling exercises are consistent with actual observations of water quality and the analysis of water quality monitoring data. One comprehensive analysis of trends in a large number of water quality measures covered the period 1974-198 1. Stations showing improvements in bacteria and dissolved oxygen levels outnumbered stations showing declines (substantially in the case of bacteria); but fewer than 20% of the stations showed improvements in these measures. As for phosphorus and suspended sediments, the percentage of stations showing improvements (11% and 14% respectively) were approximately equal to the percentages showing declines (13% and 13% respectively). Stations showing increasing trends in nitrates outnumbered those showing decreases by *4.5* to one. The authors attribute this largely to increases in fertilized agricultural acreage and to atmospheric deposition of nitrates in eastern watersheds.

Economic Issues

From an economic perspective, not all interventions in behalf of environmental protection are desirable per se. Some may cost more than they are worth — not only in terms of private market values but also in terms of individual and social welfare. Governmental intervention to control pollution is justified on grounds of economic efficiency if the beneficial effects (broadly defined) to society as a whole from such action outweigh the costs. Examinations of costs and beneficial effects should become an integral part of the process of establishing pollution control objectives.

Unfortunately, there have been no studies of the aggregate national benefits of the CWA that deal in a fully satisfactory manner with all phases of the relationship between policy induced reductions in pollution and the values of improved uses of our waters. Lacking any fully satisfactory national aggregate benefit estimates, the analyst who wishes to make a benefit-cost comparison for the CWA must do so through some kind of synthesis and extrapolation from the most soundly based of existing studies.

I prepared such an estimate of national benefits for the Council of Environmental Quality in 1979. It was based on a review of approximately twenty empirical studies. Estimates of benefits were provided for four broad categories: recreation, nonuser benefits stemming from aesthetic and ecological changes, improved productivity of commercial fisheries, and a variety of diversionary uses including municipal and industrial water supplies.

The national benefits to the U.S. population in 1985 were estimated to be at least $5.7 billion per year (in 1984 dollars), although they could be as high as $27.7 billion per year. The most likely value is $14.0 billion per year. Of this total, about half is due to improvements in water-based recreation opportunities.

Based on data from the Council on Environmental Quality and the Environmental Protection Agency, a reasonable estimate of the annual costs of complying with the CWA for the year 1985 is roughly $25-30 billion (in 1984 dollars). This is substantially higher than the most likely estimate of the benefits to be realized in 1985. In fact, the range of the estimates for benefits ($5.7-27.7 billion) barely overlaps the bottom end of the estimated range for costs. On balance, therefore, it appears that the benefit-cost relationship for the CWA is unfavorable.

This suggests that it is important to seek ways that present policies could be modified to improve the benefit- cost relationship. Broadly speaking, there are two such avenues to be investigated.

The first involves lowering targets or pollution control requirements where, at the margin, the costs of current controls substantially exceed the benefits. If we were to adopt the principle that policies should be designed to maximize the net benefits from pollution control activities, then effluent limitations on individual dischargers would emerge as the result of a two-part analytical process. The first part would involve the establishment of a set of water quality standards for each water body so that the incremental or marginal benefits of raising water quality to that point just equal the marginal costs of doing so. In those cases where marginal pollution control costs were high, the resulting water quality standards might be lower than the fishable-swimmable national target. But in other cases this economic benefit-cost approach might lead to very high standards for water quality.

The second part would then involve determining the individual effluent limitations necessary to meet the water quality standards for each water body. These requirements might vary across dischargers not only because of differences in industrial processes and control technologies but also because of differences in costs and impacts on water quality. This approach to policy making could save resources by imposing fewer stringent effluent limitations where the marginal costs of achieving fishable-swimmable water quality were greater than the marginal benefits of doing so.

The second avenue involves seeking ways of reducing the costs of achieving the existing goals, that is, by improving the cost-effectiveness of pollution control policy. By cost-effectiveness economists mean meeting water quality standards at the lowest possible total cost. The importance of achieving cost-effective pollution control policies should be self evident. Any cost savings that can be achieved frees resources that can be used to produce other goods and services of value to people. If some change in the allocation of cleanup requirements among dischargers results in a lower total cost of controlling pollution without degrading water quality, then society is clearly better off.

A pollution control policy is cost-effective only if it allocates the responsibility for cleanup among sources so that the marginal cost of improving water quality at any location is the same for all sources. Differences in the marginal costs of improving water quality can arise both from variations in the marginal cost of reducing discharges across sources and from differences among sources in the effect of discharges on water quality.

A major criticism of technology-based standards from an economic standpoint is that they are virtually certain to result in higher than necessary total costs for any particular level of water quality. There is nothing in the logic or the procedures for setting technology-based limits to assure that the conditions for cost minimization will be satisfied. Since the marginal cost of control is not systematically considered, technology-based standards are not likely to result in equal marginal costs across sources. There is ample evidence that marginal costs of control do vary widely across sources now.

There are several modifications of present policy that would go a long way toward improving its cost-effectiveness. The one most favored by economists in the past has been to place a tax or charge on each unit of each pollutant discharged and to allow each discharger to choose the degree of cleanup that minimizes its total cost (cleanup cost plus tax bill). The effluent charge strategy provides a certain and graduated incentive to firms by making pollution itself a cost of production. And it provides an incentive for innovation and technological change in pollution control. A properly designed system of effluent charges will also be cost-effective because all sources will equate their marginal costs of control with the charge.

Another approach with essentially the same incentive and cost minimizing effects is a system of tradeable or marketable discharge permits. The pollution control agency could issue a limited number of pollution permits or "tickets." Each ticket would entitle its owner to discharge one unit of pollution during a specified period. The agency could either distribute the tickets free of charge to polluters on some basis or auction them off to the highest bidders. Dischargers could also buy and sell permits among themselves.

A small step toward obtaining the economic advantages of tradeable discharge permits is the application of the "bubble" concept to water pollution control. In a major industrial facility such as an integrated steel mill there may be several separate activities or processes, each subject to a different effluent limitation. Many of these activities discharge the same substance. Yet the marginal costs of control may be quite different across activities. As a result, the total cost of controlling the aggregate discharge from the plant is often higher than necessary. In such cases, plant managers should be allowed to adjust treatment levels on different activities if they can lower total treatment costs as long as the total amount of a pollutant discharged from the plant does not exceed the aggregate of the effluent limitations for individual processes. EPA is now allowing such bubble tradeoffs at integrated steel mills if the tradeoffs result in a net reduction of the total amount of pollutants discharged. Present law should be modified as necessary to facilitate similar intraplant trades in all industrial categories.

Conclusions

Three major themes can be traced through this discussion of water pollution control policy. They are: the importance of comparing benefits and costs, the value of seeking more cost-effective control programs, and the potential role for economic incentives such as charges or marketable discharge permits.

We saw that in aggregate it appears that the costs of the present policy substantially outweigh the benefits. Yet if the goal of fishable-swimmable water quality is to be met everywhere, even more costs will have to be incurred, If it is accepted that the resources presently devoted to water pollution control are scarce, involve opportunity costs, and may have more valuable uses in other activities, then a reconsideration of some water quality goals may be in order. This may mean accepting less than fishable-swimmable quality water where the costs of obtaining it are inordinately high.

We have argued that one way to improve the benefit-cost relationship of the existing policy is to seek more cost- effective means of achieving given standards. The emphasis on equal treatment of dischargers or uniformity of cleanup requirements has meant that the cost of reaching present water quality objectives are substantially higher than necessary. This means fewer of society's resources are available for other valuable uses. More emphasis should be given to the development of cost-effective means of achieving targets. We have discussed the potential role of charges or marketable discharge permits in moving toward a more cost-effective pollution control policy.

Finally, progress toward attaining water pollution control objectives has been slow. Time-tables have not been kept, and deadlines have been reached and passed without full compliance with the legislated objectives. These shortfalls in implementation are due in substantial part to the complexities of the task. But a major share of the responsibility for the slow pace of progress must be assigned to the inappropriate incentive structures created by the regulatory approach to pollution control. There are many opportunities for restructuring incentives through marketable discharge permits or effluent charges.