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Valuing Clean Water in North Carolina

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How valuable is clean water to the people of North Carolina, and how should the answer to this question affect the design of water quality policy in the state? On one hand, clean water is priceless, since without it life cannot exist. On the other hand, there are many other everyday uses of water that, while typically not associated with life-support importance, nonetheless contribute greatly to life's enjoyment. These include, among other things, the availability of clean rivers and lakes for recreational use and wildlife habitat.

Since we normally don't pay to use water in these ways, how is its value measured? What does it mean to examine the worth of something that is indispensable, yet is also an item that is rarely paid for in the traditional sense? This edition of the *NC State Economist* offers insights into how an economist might think about these questions, suggests why these dollar values are important for informing the debate on water quality policy in the state, and demonstrates a technique for actually measuring dollar values for water quality.

National Water Quality Policy

Water quality regulation at the national level is currently being revamped to reflect new realities in sources of water pollution. When the Clean Water Act was passed in 1972, the primary concern was "end of the pipe" point sources of pollution from municipal wastewater and industrial sources. The Clean Water Act imposed technology standards that have resulted in substantial reductions in pollution from these sources, to the point that they no longer represent the primary threat to water quality in the country. Rather, diffuse sources of pollution from large numbers of smaller polluters (non-point sources) are now the main concern in many areas.

As a result, debate on regulation is beginning to shift away from technology standards for point sources and towards ambient water quality standards for individual water bodies. The legal impetus for this is the Total Maximum Daily Load (TMDL) provision of the original Clean Water Act. The TMDL provision requires that (a) individual water bodies not meeting water quality standards be identified; (b) a process be initiated for prioritizing cleanup among these water bodies; and (c) ambient standards be agreed upon in the form of an allowable daily pollution load from all sources, including non-point sources.

Responsibility for the steps in the TMDL process lies with state regulators, who are given considerable discretion in arriving at standards. For example, in designing TMDLs for individual water bodies "…social and economic benefits (of the bodies of water) are to be considered by decision makers…" (quoted in Boyd, 2000), and public discussion and documentation is required at each step in the process. Thus, federal TMDL regulations suggest the importance of understanding the benefits of water quality.

Concerns about water quality in North Carolina parallel national concerns. The state has recently seen rapid growth in its urban areas and expanding crop and animal agriculture operations, each of which have contributed in some degree to degrading the state's waterways. In the specific context of TMDLs, state officials are engaged in the design and enforcement of regulation to improve water quality in the state. These efforts have resulted in the familiar topics of debate, including the search for improved animal waste technologies, the development of best agricultural management practices for minimizing pollution due to agriculture, and the importance of open space in urban areas as a protection against urban runoff.

Water Quality – A Non-Market Good

The economist's role in this debate is to note that water quality, like any other good, conveys benefits to its consumers but is also costly to provide. From the perspective of economic efficiency, the ideal level of consumption of any good is such that the cost of providing the last unit of that good – the "marginal cost" – is just equal to the benefits provided by that last unit. Best agricultural management practices, urban open space, and improved animal waste management are examples of steps that can be taken to improve water quality. Since these steps require public and/or private resources, they are costly. Examples of the benefits of improved water quality include enhancement of the health and aesthetic amenities, recreation opportunities, and wildlife habitat services that water resources provide.

For most goods, the invisible hand of the market ensures that costs and benefits are balanced in the provision of the item. As such, in market economies no government intervention is needed to ensure that, for example, the proper number of short sleeve shirts are made available before summer. Water quality, in contrast, is not traded in the market; thus there is no guarantee that the proper level of water quality will occur. In this case there is a role for government regulations to promote a level of water quality that brings the benefits and costs of clean water into balance. This requires that benefits and costs be measured, and suggests a reason that we are interested in measuring the value, or benefits, of water quality, both in general and in the specific context of TMDL regulations.

Travel Cost Models

The measurement of benefits is complicated by the non-market nature of water quality. We cannot simply observe how much money people are spending on the good to get a sense of its value to them. Instead, economists use indirect techniques to gauge that value (or components thereof). One such method designed to gauge the value of water quality in recreation services is the ***travel cost model***. The travel cost model originates with the observation that taking a trip to a water recreation site is costly in spite of the fact that typically we do not pay a market price for using the resource. Rather, the costs take the form of travel expenses and the value of the time spent in travel. By taking a trip, a visitor reveals that the value of the service he or she gains from the site is at least as great as these implicit expenses. By quantifying the expenses recreation site visitors face, we can deduce a "price" of taking the recreation trip. In most cases we expect that, all else being equal, people will consume greater quantities of a good the lower its price. Translated to the travel cost model, this suggests that over time people will take more trips to water recreation sites that are closer to their homes (and hence have lower access costs).

Price, however, is not the only factor that may influence people's decisions. If the water quality is better (so that the fishing or swimming experience is superior) at a more distant site, people may be willing to travel further and incur greater costs in order to enjoy better water quality. Measuring people's willingness to tradeoff travel expenses for higher water quality is central to measuring the benefits of improved water quality in recreation services. Just as the difference in unit price between a round steak and a fillet is a measure of people's willingness to pay for higher quality beef, the decision by a person to drive further to a better site reflects a willingness to pay for a higher quality recreation site

The travel cost model suggests there is a relationship between people's visits to available water recreation sites (their demand for visits) and the implicit price and water quality available for each site. This relationship can be quantified by comparing survey data on household trip taking decisions with data on water quality readings taken at the water bodies of interest. Such quantification allows economists to infer – in dollar terms – people's willingness to pay for improved water quality at recreation sites.

A North Carolina Study

I recently conducted a travel-cost study to quantify the benefits to recreation users of reduced nutrient pollution in North Carolina's surface waters (Phaneuf, 2001). Using a model that analyzes individual trip-taking behavior to water bodies throughout the state, I found convincing evidence that people tend to visit recreation sites with higher levels of water quality. Furthermore, I found that people are willing to pay additional money, in the form of increased travel expenses, in order to enjoy higher levels of water quality.

These results can be used to analyze the benefits of potential water quality improvements for recreation visitors. For example, the data indicate that improving water quality in the Neuse River basin so that nutrient levels are below EPA standards would be worth, on average, $0.81 per trip for North Carolina visitors. Similar improvements in the Cape Fear and Tar-Pamlico basins would result in average per trip benefits of $1.00 and $0.44, respectively. Using a very rough figure of 14.7 million water recreation trips per year by North Carolina residents, annual benefits from these improvements can be approximated as $11.9 million for the Neuse improvements, and $14.7 and $6.5 million for the Cape Fear and Tar-Pamlico improvements.

Conclusion

The design of effective water quality policy must proceed along several dimensions, taking into consideration issues of ethics, fairness, and distribution as well as cost and benefit analysis. The economist's contribution to this process is to note that policy should seek to balance the marginal costs of water quality regulations with the marginal benefits resulting from the improved quality, and to suggest techniques for measuring the costs and benefits. This essay has focused on the challenges associated with benefits measures and described a technique for measuring the recreational benefits of improved water quality. The example study that was highlighted suggests there are substantial benefits to recreation users in North Carolina of improvements in surface water quality.

As with any scientific research, the results of this study must be properly interpreted and the limitations acknowledged in order for them to be of use for informing policy. The value estimates reported include only recreation benefits and therefore should be interpreted as an underestimate of the total value that is associated with improving water quality. Likewise there is always uncertainty and natural variation in these types of figures; as such, benefits calculations should be treated as scientifically informed best estimates rather than absolutely accurate. Nonetheless, benefits estimates like those presented in this essay can help answer the question of what improvements in water quality are worth, and more importantly, help inform the debate on the proper level of water quality regulation.

References

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