Universities Council on Water Resources
Journal of Contemporary Water Research & Education
Issue 138, Pages 3-6, April 2008

Introduction to the Issue: The Role of Science in Watershed Management

Burrell E. Montz

Department of Geography, Binghamton University

The June 2007 issue of this journal featured a special focus on Water and Watersheds centered on the results of an NSF-EPA-USDA partnership that led to a number of research projects integrating the physical, ecological, and social sciences (Firth and Kelleher 2007). The papers in that issue were examples of research undertaken with funding from that partnership. This issue builds on that theme, focusing largely, but not exclusively, on one watershed, the Upper Susquehanna Basin, and stems from a workshop held in May, 2007 by the Center for Integrated Watershed Studies (CIWS) at Binghamton University, "The Role of Science in Watershed Management." This workshop was designed to bring together natural scientists, social scientists, and policy makers to discuss current issues, related research, perceived needs for information, and obstacles and opportunities for interaction between science and management. These goals reflect the mission of CIWS, specifically to draw together investigators with diverse expertise and interests in watershed studies in the hopes of integrating the latest knowledge across all disciplines pertaining to watershed management. The sixty participants came from various universities, from local, county, and state government, and from watershed organizations, ranging from the Chesapeake Bay Commission to the Susquehanna River Basin Commission to the Upper Susquehanna Coalition.

The workshop was organized around several plenary speakers, representing three critical areas in watershed management: ecology, hydrology, and policy making. Each centered his or her presentation around current research projects, findings, and needs for future work. These were followed by breakout sessions centering broadly on these areas, but focusing on how the science can and should be translated for managers with an emphasis on local concerns and needs in the Upper Susquehanna River Basin. Specifically, these sessions covered nonpoint-source pollution, land use impacts, flooding, environmental education, stakeholder concerns, and emerging issues. In all sessions, the interaction between science and policy was incorporated with an eye to developing a research agenda and priorities for action.

Linking Science and Management

The link between science and public policy is exemplified in the Chesapeake Bay Program, as noted in the Foreword by Peter Freehafer. As he points out, in watershed management, no matter what the area of concern, we are working in a dynamic system that changes naturally and in response to anthropogenic activities. Whether the issue is nonpoint-source pollution emanating from agricultural activities or flooding that generates calls for modification of streams and rivers, the role of science in providing the foundation for sound public policy cannot be ignored. However, the relationship is not a smooth one because of different temporal and spatial scales at which the two work. With regard to the former, scientific knowledge is ever-changing. Policies and management plans require reliable scientific information and they take time to craft and more time to implement. Similarly, scientific studies address locations and scales that reflect the problem studied, whether that is agriculturally-generated nitrogen inputs to rivers and streams, the impacts of land use changes on water quality and runoff, or losses to floods, whether within individual watersheds, a series of nested watersheds, or entire river systems at a local, regional, or national scale.

In some cases, the boundaries of analysis coincide with political boundaries, but often they do not. Even when they do, however, action is not necessarily forthcoming for a variety of reasons, including different perceptions of the problem and appropriate solutions, different understandings of connections among the physical, economic, social, and hydrologic factors at work, and different priorities among the parties engaged in a given issue. These difficulties play out in every watershed, whether large or small, local or national, though the significance of individual factors may change depending upon spatial and temporal scales. In addition, problems are not generally watershed-specific; the impact they have ecologically, hydrologically, and economically will likely vary from watershed to watershed. Still, the lessons learned and the research approach adopted in one location can be applied to other locations, taking local and regional variations into account. Thus, the papers in this issue present different research foci, sometimes at different scales, with the underlying goal of applying sound science to watershed management.

The Upper Susquehanna River Basin

Because Binghamton University is located in the Upper Susquehanna River Basin, that region serves as the focus of much of the work of CIWS, and as the study area for a number of papers in this issue (Figure 1). This basin is a small part of the Susquehanna River Basin, comprising 4,944 square miles, 18 percent of the total of 27,510 square miles. At the same time, the Upper Susquehanna's population of approximately 475,000 represents 11 percent of the entire river basin population. This sub-basin is important to the Susquehanna River and, especially to the Chesapeake Bay because it accounts for approximately 15 percent of the nitrogen, 24 percent of the phosphorus, and 14 percent of the sediment load to the Chesapeake (Chesapeake Bay Program 2006). Thus, understanding the dynamics within the

Figure 1. The Upper Susquehanna River Basin.

Upper Susquehanna, in stream, on the land, and within political units, is a necessary precursor to managing larger spatial units, such as the river basins that shape the health and economies of these basins and associated bays and coastal areas.

The issues that the Upper Susquehanna faces are similar to those of countless watersheds, no matter what the size. Nonpoint pollution from agriculture and urban runoff, municipal and industrial discharges, and impacts associated with too much and too little water are of great concern, but are also not often high on policy agendas until or unless a crisis is looming or occurs. The June, 2006 floods in Broome County, New York provided an example of this. Several important areas of need emerged from the workshop including:

1. The need to focus on what is achievable overall and at a given point in time, perhaps building on the window of opportunity for policy decisions that is frequently provided by crises such as flooding;
2. The need to develop connections between issues or concerns, such as addressing nitrogen pollution through flood management because flooding generates compassion while nitrogen does not; and
3. The need to understand conflicts among interested parties with different priorities, goals and approaches, including those upstream and those downstream, and those paying and those benefiting.

In all cases, the importance of a solid scientific foundation was recognized as a fundamental starting point. So, too, was education – of the next generation of scientists and policy-makers, of stakeholders, and of politicians.

The papers in this special issue reflect many of the ideas and themes of the workshop, though not all are centered on the Upper Susquehanna Basin. The overarching importance of the work represented in this issue is reflected in Freehafer's Foreword, which puts the research in a broad, management context. Woodbury, Howarth, and Steinhart provide an overview of the work undertaken in a number of departments at Cornell University, along with colleagues from other institutions, aimed at understanding the dynamics of nutrient cycling and at sharing findings and data. The various research projects underway through the Agricultural Ecosystems Program illustrate the kind of work that has widespread applications and implications both within the Upper Susquehanna and elsewhere.

The contributions by Zhu, Graney, and Salvage and by Graney, Salvage, and Zhu focus on a small watershed on the Binghamton University campus. Not only does this study site offer an accessible field laboratory that incorporates different land uses, land covers, and ecosystems to analyze pollution and the role of wetlands, but it also provides an important educational laboratory for students to work in interdisciplinary teams to evaluate watershed processes. Using nitrogen as the focus, Zhu and his colleagues address biogeochemical processes through various watershed scales, from the Chesapeake Bay watershed to the watershed at Binghamton University. Graney, Salvage, and Zhu then concentrate on the educational role such a watershed can play for a number of disciplines.

A tool that has been critical to watershed science and management at a number of scales is Geographical Information Systems (GIS). Looking at a watershed downstream from the Upper Susquehanna Basin, Bruns and Fetcher use one GIS-based application, CITYgreen, to evaluate economic and ecological values and benefits in an area currently under pressure from urban sprawl. The results of their analysis demonstrate the benefits of maintaining forest cover in terms of reduced air pollution and storm water control. Such a study has direct application to land use management and provides strong impetus for managing sprawl at various political and watershed scales.

Given that the Susquehanna is one of the most flood-prone watersheds in the country, averaging some $150 million per year in flood losses (Susquehanna River Basin Commission 2007), and that a flood of record affected the Upper Susquehanna Basin in June, 2006, the topic of flood damages and flood hydrology is an important one. In the first paper on floods, Changnon presents an overview of the magnitude of flood losses, while controlling for the sources of flooding. Understanding the nature of the problem, again, both economically and hydrologically at the national level is important to putting the June, 2006 experience in context. In fact, as Changnon points out, New York is second in the country in terms of flood losses from all causes. The 2006 floods were significant contributors to that. Knuepfer and Montz's contribution discusses that event, looking first at the hydrology of the event and then at the complex of factors that contributed to its severity. The results of their analysis illustrate a common conflict in watershed management: decision-makers who are trying to take science and translate it into effective management policy and those, primarily politicians, who want to fix the problem in response to constituents' interests.

Conclusions

The papers in this issue present a wide range of approaches and concerns that are prevalent when science tries to meet management, and vice versa. One cannot formulate sound policy without a strong scientific foundation; frequently policy-makers are not aware of the magnitude or significance of a problem until it is brought to light by scientific research. It is clear from the research presented here that there are numerous efforts aimed at understanding watershed dynamics, processes, and interactions– all of which can have direct application to watershed management. Water and watershed management involves complex relationships. The critical issues related to watershed science and management present challenges that demand integrated approaches, collaborative efforts across disciplinary boundaries, and feedback between researchers and policy makers. The papers presented here represent different foci, all directed to the challenges described above.

Author Bio and Contact Information

Burrell Montz is a Professor of Geography and Director of Graduate Studies in geography at Binghamton University. Her research focuses on human responses to hazards and disasters, especially floods, in particular vulnerability of populations and recovery from disasters. Email: bmontz@binghamton.edu.

References

Chesapeake Bay Program. 2006. *Tributary Strategy Tools*. http://www.chesapeakebay.net/tribtools.htm. Last accessed 18 December 2007.

Firth, P. and M. Kelleher (Editors). 2007. Water and Watersheds. *Journal of Contemporary Water Research and Education*. 136, 93 pp.

Susquehanna River Basin Commission. 2007. *June 2006 Flood: A Summary of the Flood and Performance of the Susquehanna Flood forecast and Warning System*. Harrisburg, PA. 8 pp.