

CHAPTER 12

FRESHWATER MANAGEMENT IN COASTAL REGIONS

Richard Volk

THE EMERGING GLOBAL WATER CRISIS

During the past century, the world's population tripled while human demand for freshwater increased more than six-fold. As the population grows by approximately 80 million people each year, freshwater demand grows by about 64 billion cubic meters—an amount equivalent to the entire annual flow of the Rhine River. Of course, there is no more freshwater on Earth today than there was 2,000 years ago when the population was less than 3 percent of its present size.

Although Earth is water-rich and known as the “blue planet,” over 97 percent of its water resources are salty or brackish. Of the less than 3 percent remaining that is freshwater, the majority is tied up in inaccessi-

ble polar ice caps, glaciers, or deep aquifers. This leaves about 0.03 percent of total water that is accessible—in rivers, lakes, and shallow aquifers—for human use. But even that water is not evenly distributed in space or time, or located where the largest concentrations of people reside.

Today, more than 480 million people (8 percent of the population) face serious shortages of freshwater. By the year 2025, however, that number will grow to about 2.8 billion people (35 percent of the projected population). Although a majority of the projected water-scarce countries will be in the Near East and Africa, virtually every region of the globe will face water shortages to varying degree.

The worldwide freshwater demand is being pushed to new heights by industrialization, irrigated agriculture, massive urbanization, rising standards of living, and growing populations. Another way to look at demand is the fact that slightly more than one-half of available freshwater supplies are now used for human purposes, and the world water demand is doubling every 20 years.

THE RELATIONSHIP OF FRESHWATER MANAGEMENT TO COASTAL MANAGEMENT

There are many dimensions to the emerging global water crisis, but of special interest to coastal managers are changes to water quantity and water quality that affect coastal ecosystems and their human inhabitants.

We know that water quality profoundly affects human health. Today, roughly 20 percent of the world's population (1.2 billion people) lacks access to clean water, while roughly two-thirds of the population lacks access to sanitation. This translates into a significant portion of illnesses in the developing world that are attributable as water-related diseases, including four billion cases of diarrhea resulting in three to four million deaths each year. Of course, there are a multitude of human health issues associated with how freshwater is managed, but a full discussion of them is beyond the focus of this chapter.

On the environmental health side, we know that some 80 percent of total pollutant load to the marine environment is derived from land-based activities, including both point and nonpoint sources. In the U.S. during the period 1972 - 1992, approximately US \$125 billion was spent to construct or expand publicly owned treatment plants, with federal grants picking up about 75 percent of the costs. Developing countries, as a whole, are nowhere close to achieving the same level of infrastructure, and so point source discharges remain a huge and growing threat to the health of coastal ecosystems and their human residents.

On the other hand, improvements in nonpoint source control have been slow everywhere, in both developed and developing countries. This is due to the large number of diffuse sources, a general resistance to regulatory solutions, and the multiple pathways through which pollutants may reach coastal and ocean environments. Pollutants from nonpoint or diffuse sources include those released into the atmosphere through the burning of fossil fuels and other wastes, as well as water runoff from the land carrying—among other pollutants—pesticides, oil and grease, nutrients, and sediments.

Continuing with this snapshot of freshwater quality and quantity issues, humans have been in the business of building dams for water storage for many decades—or actually centuries. Today, there are over 45,000 large dams (defined as being 15 meters or greater in height) in over 150 countries. Over half of these are located in China. But there are a much larger number of smaller ones as well. The U.S., for example, has nearly 5,500 large dams and over 100,000 small dams. Although most planners believe that the era of large dam construction has passed its peak, the world community is still constructing an average of 200 - 250 new large dams each year.

There is now compelling evidence that humans have become a significant force in the transformation of the earth's hydrology. In a number of ways—both direct and indirect—we are significantly altering the volume, timing, and quality of freshwater flows to the estuarine and marine envi-

ronment. Human demand for freshwater is outpacing supply, and we have responded by constructing more and ever-larger dams and pipelines for inter-basin transfers. We are profoundly reshaping important landscape features, including forests that serve to naturally regulate water runoff. We allocate close to 80 percent of our available water supplies to often water-inefficient agricultural systems. We are destroying wetlands and losing their free ecological services. We are undergoing rapid and massive urbanization, where we are concentrating water demand and waste loads at unprecedented scale. And finally, with global warming, we face the prospects of altered patterns of precipitation and evaporation, and more frequent and severe storms.

What does this all mean for the estuarine and marine environment?

ESTUARIES AND THE EFFECTS OF ALTERED FRESHWATER INFLOWS

It is important to understand that freshwater is what defines an estuary. Estuaries are biogeographic features where usually colder freshwater from the land flows into and on top of denser saltwater from the sea. A salinity gradient is formed—from fresher to more saline—moving from an estuary's upper tidal reaches towards the ocean or sea. Water temperature and density differences result in considerable mixing of the fresh and salt waters.

The word “estuary” comes from the Latin root “estuary” which means “to boil, surge, or be in commotion.” The vertical mixing of the water column described above, coupled with tidal and wave energies and replenished nutrient supplies from water runoff from the land, allow these to be the most productive ecosystems on earth in terms of energy transfers and biomass production. As a result, estuaries offer a myriad of free ecological goods and services, and it is little wonder that humans have demonstrated a propensity to settle on their shores throughout history.

But just why are freshwater flows so critical to the health and productivity of estuaries? There are many reasons, but the three most important contributions from flows are: salinity gradient, nutrients and sediments.

Although there are many kinds of estuaries with a wide range of defining characteristics, estuarine species have evolved over time to be adapted to a range of salinities, especially during their juvenile life stages. The salinity gradients act as physical barriers to marine predators, parasites and disease, giving estuaries their special significance as nursery areas. Nutrients are essential for biological productivity and are delivered by flows from throughout a river basin. Likewise, sediments are needed to maintain the physical morphology of shorelines, including that of barrier islands, dunes, beaches and adjacent wetlands.

When freshwater flows are reduced, either naturally as during drought or through human activity (from dams, diversions, or other landscape changes), tidal waters extend further into the upper estuary. Overall salinities increase, and there is less vertical mixing of the water column. As already mentioned, such conditions allow marine predators and parasites to move further into the estuary and wreak their havoc on estuarine species. Meanwhile, fewer nutrients are brought into the system, translating into reduced biomass production and changes to biotic community structures. A reduced influx of sediment can lead to increased coastal erosion and the loss of wetlands. As saltwater intrudes into coastal aquifers, human communities that rely on this source of freshwater are faced with yet another set of challenges.

INCORPORATING AN INTEGRATED WATER RESOURCES MANAGEMENT APPROACH INTO INTEGRATED COASTAL MANAGEMENT

Despite the emerging global water crisis and its particular impacts on ecosystems and people, most experts agree that the goal of achieving global water security is not limited so much by water scarcity, but by the

absence of effective management of water resources. In recent years, the global community of water resource managers has come to fully realize the interconnected nature of hydrological resources, and has embraced Integrated Water Resources Management (IWRM) as an alternative to the sector-focused, top-down management styles of the past.

Several key principles are now recognized as essential precursors to effective IWRM. First among these is the recognition that water resources must be managed at the basin or watershed scale, including the integration of land and water, upstream and downstream, groundwater, surface water, and coastal resources. Closely tied with this principle is the recognition that it is critical to utilize an inter-sectoral approach to decision-making. Basin-scale issues involving multiple sectors require serious investments of time and effort to establish a transparent and fully participatory process involving all relevant stakeholders. It is only by forging a common vision and sense of mutual trust and respect among these diverse interest groups that IWRM can be sustainable over time.

Secondly, today's water resource managers recognize that enabling policies, laws, and institutions are essential precursors to successful IWRM. Just as with integrated coastal management (ICM), water resources management is primarily an effort in improved governance. The effort to harmonize policies, laws, and institutional frameworks is an essential first step, and one that should take place simultaneously at all relevant levels of government. While the goal in most cases should be to decentralize the authority for water resources management to the lowest appropriate level, that can only be achieved with approval and commitment from the country's highest executive and legislative officials. Decentralizing authority to the lowest appropriate level will help to ensure close linkage between the users of water resources and those who must be held accountable for water resource sustainability.

Finally, successful IWRM must invest in the accumulation of data, information, and reliable knowledge to help guide decisionmaking. Sound science is an integral component of any resource management endeavor

today, and is no less important in the field of water resources management. Understanding a river basin's water budget is fundamental to any discussion on how water resources should be allocated among the many human and ecosystem needs for freshwater. The collection and analysis of relevant data—including hydrological, environmental, economic, and social data—are best approached under the auspices of the relevant river basin organization which will call upon such information to promote consensus on a given course of management action.

Readers who are familiar with global trends and developments in the field of ICM will have recognized that these three key principles of IWRM—an ecosystem approach; democratic governance based on improved policies, laws and institutions; and the use of sound science for management—are the same key principles that govern today's most successful ICM efforts. As coastal practitioners become more informed of the efforts of their freshwater colleagues, they will likely find that not only the key principles, but also many of the tools and methods that underlie consensus-building and governance development processes in the field of IWRM are much the same as those for ICM.

Adopting a river basin approach, however, is no small endeavor, and coastal practitioners will need to be highly strategic in deciding how best to connect with such initiatives. Clearly, the successful management of freshwater is of central importance to coastal resources management, and every effort should be made to support an IWRM agenda wherever such programs are in place. And where such broader, more holistic thinking about national or regional freshwater resources is lacking, it may be critical that coastal managers step forward to promote such dialogue. Coastal managers have not only an environmental, but also a social and an economic imperative to do so.

But after that is said and done, it must also be recognized that the growing urgency and complexity of issues that confront estuarine and marine environments worldwide will continue to require their own investment in science, education and governance. The complexity and scale of ICM

issues necessitate multi-disciplinary dialogue and inter-sectoral coordination that is—albeit overlapping with the IWRM dialogue—unique and deserving of its own parallel focus.

The quantity and quality of freshwater flows to coastal ecosystems will be of increasing concern for billions of people as the global water crisis deepens. The social, economic and environmental consequences of present trends are at once sobering and a call to action. As coastal managers, if we are to succeed in our goal of sustainable development for coastal communities, we cannot ignore the central importance that successful freshwater resources management will ultimately play in our achievement of that goal. It is of tantamount importance that—without further delay—we begin the dialogue with our water resource manager counterparts, and that we begin to understand and incorporate an IWRM approach into ICM. Not only will downstream communities and ecosystems benefit from this collaboration, but so too will IWRM and its river basin management programs. The field of ICM has a rich history of experience in stakeholder processes that should be of considerable value to water resource managers. Most importantly, we must collectively work to dissolve the often-arbitrary distinction of interests that separate our upper basin, lower basin, and coastal communities. The time has come for a proper recognition of the ecological continuum that exists from the upper reaches of a river basin to the outer edges of its submerged marine landscape.

CRAFTING COASTAL GOVERNANCE IN A CHANGING WORLD

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A great many people in USAID, in CRC and in the countries where we have worked have contributed to what has been achieved and learned. The authors of this volume thank everyone involved for their creativity, their energy and their leadership in addressing the complex issues in coastal regions. Most especially we thank our in-country teams and our partner institutions who taught us how what was being learned elsewhere could be appropriately applied to their own cultures and the needs of their countries. We have not attempted to list all those that have contributed to the ideas and the experience presented in this volume. To do so would require several long paragraphs.

While so many contributors to the program, one name stands out: Lynne Hale, former associate director of CRC. Lynne left CRC in the last year of the program—but only after setting in motion the drafting and redrafting that has resulted in this volume of reflections, experience and future directions. Lynne was CRC's point person with USAID. She led the design of the CRMP II field programs and made sure that they capitalized on what had been learned from the first set of field programs. Throughout the 18 years of the program Lynne's passion, perseverance and perception made it the success it became. All who have contributed to this volume thank her and wish her well in the next stage of her career.

PREFACE

OCEANS, COASTS, WATER, AND THE EVOLVING USAID AGENDA

By Bill Sugrue

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Since 1985, the U.S. Agency for International Development (USAID) has partnered with the University of Rhode Island Coastal Resources Center (CRC) in carrying out the Coastal Resources Management Program (CRMP). CRMP is a pioneering initiative working with developing countries around the world to advance the principles and practices of integrated coastal management (ICM). During this 18-year partnership, USAID and CRC, together with partners in the field, have learned a great deal about the complexities and challenges of better managing our coasts. This has included learning how to balance the need for ecologically healthy coasts with the need to promote a better quality of life for those who live and work there. Throughout this process, CRC has been an instrumental force in promoting a “learning agenda” for (ICM). In the selected CRMP stories included in this book, you will share in some of that learning. Let me summarize here some of the key principles that underlie the ICM learning agenda.

ADVANCE INTEGRATED WATER AND COASTAL RESOURCES MANAGEMENT FOR IMPROVED ENVIRONMENTAL PROTECTION AND MANAGEMENT

It is essential that ICM and integrated water resources management (IWRM) be mainstreamed into sustainable development efforts. ICM and IWRM are essential foundations for improvements in health, food security, economic development, democracy and governance, and biodiversity conservation. We must recognize the interdependence of these development goals. The interdependence of human health, food security, governance and the other human activities is obvious. How development objectives are pursued in these sectors can have dramatic impacts on biodiversity, and on the biosphere. The biosphere is currently in free-fall, so the significance of these impacts is not trivial. Conversely, biodiversity conservation programs, properly conceived, can significantly support CRMP objectives in economic development, food security, governance and other areas. The challenge to development assistance organizations is to ensure that they move beyond single sector responses to more integrated, cross-sectoral approaches that do justice to the exceedingly complex and interrelated factors that shape our world. Principles of integration as practiced in ICM and IWRM must be given the commitment of time and resources that they deserve.

CREATE STRONG GOVERNANCE AT ALL LEVELS

Good governance is more than just good government. It encompasses a range of processes in which public, private and civil societies organize and coordinate with each other to make decisions, and distribute rights, obligations and authorities for the use and management of shared coastal resources. A central operating principle of the CRMP has been that effective governance systems are what create the preconditions for achieving sustainable environmental and social benefits. We have learned that good coastal governance functions best when it exists as part of a nested system—that is, one that operates simultaneously at scales ranging from the local to the global. For example, sub-national and community-based management efforts stand the best chances to be effective and to be sustained

over the long term when they are supported by policies and institutional structures at the national level. Meanwhile, national-level initiatives build capacity for ICM governance across spatial and sectoral scales, providing support to local initiatives while addressing coastal development and conservation of more wide-ranging national interest.

PROMOTE PRIVATE AND PUBLIC PARTNERSHIPS

Participatory approaches to conservation are now recognized as one of the few means to ensure sustainable management of ecosystems and natural resources while also meeting local peoples' livelihood needs. This participation is most effective when it includes both the public and private sectors. ICM and IWRM are too complex for one institution or group of constituencies to "go it alone." Forging carefully selected, strategic private-public partnerships can help.

Eco-tourism is just one of the issues around which coastal programs are testing such partnerships. The hope is that by partnering with the private tourism sector, chances improve for achieving environmentally sound, financially sustainable, and culturally appropriate coastal tourism development. When these partnerships succeed, eco-tourism can have significant, positive impacts on local economies and can provide strong incentives for sound environmental protection and management. A caution is that "environmentally sound" and "culturally appropriate" cannot be throwaway lines. They need to be taken seriously. Not all eco-tourism is very "eco," and unless there is true and transparent participation—i.e. the local community is fully engaged, not simply consulted—the impact of tourism on local communities can be destructive economically, socially, and culturally, and the impact on the environment catastrophic and permanent. It is not easy to do this right—but it is essential to do so.

EMPOWER COASTAL COMMUNITIES TO SELF-MANAGE THEIR RESOURCES

This must be done while promoting alternative livelihood and food security objectives. In cases where local social and economic networks are

already well established and thriving, even at relatively low income levels, poorly conceived outside interventions can be extremely and negatively disruptive. Since poverty is not solely a function of income, but also of control of assets, empowerment, and control over one's fate, even the most well-intentioned efforts at poverty reduction or economic growth can have the opposite effect on people if existing arrangements are not taken fully into account. This is especially worthy of consideration in the case of indigenous communities. In such cases, poverty prevention, rather than poverty reduction, may be the appropriate goal. In this way, intact communities with essentially sound traditions of resource management may best be assisted by simply strengthening and supporting their control over local resources. Only modest, incremental initiatives aimed at ensuring continued food security and additional income streams may be called for; but here again, full engagement of the community, not simply consultation, must be the norm.

ADVANCE INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING AT BOTH THE NATIONAL AND LOCAL LEVELS

Inadequate capacity to practice ICM and to design and implement strategies that lead to more sustainable forms of coastal development remains a primary factor limiting progress in ICM. Too often, development projects bring in external expertise and funding without a parallel effort to build and strengthen in-country partner organizations—leaving partner organizations and the larger ICM effort vulnerable to failure when outside assistance ends. CRMP has used a different approach. Its preference has been to strengthen institutions over extended periods of time and to transfer the skills and the responsibilities for implementation to CRMP collaborating organizations. This approach is grounded in the belief that long-term collaborative relationships with partners maximizes learning and increases the probability that productive efforts will be sustained over many years.

The CRMP experience has also demonstrated the value to be derived from cross-portfolio learning. For example, we have seen how communities in the Philippines that developed community-based marine sanctuaries were able to provide useful insights to Indonesian practitioners attempting to

establish their own marine reserves. Similarly, experience in Ecuador and Sri Lanka in the development of shoreline management guidelines helped CRMP undertake the process more efficiently in Tanzania.

While USAID, through its overseas missions, presently supports coastal and marine activities in over 40 countries, only a small handful of those USAID missions have been able to invest in a more comprehensive ICM approach, with broad attention to all of the general principles cited above. The challenge remains to enhance the dialogue between development agencies and national governments on the economic, social and environmental values of marine and coastal resources, and the proper level of investment to maintain these resources as national and local assets. These priority challenges, which must be faced, and which will help guide USAID's future directions include the need to:

- ❖ Mainstream applied fisheries research and management into ICM programs, and promote effective governance of commercial, artisanal, and subsistence capture and culture fisheries. Science and technology advances must influence decisions on coastal resource management in a context of good governance. Both are crucial.
- ❖ Establish networks of marine protected areas with substantial ecological reserves in all regions, while ensuring the sustainability of these activities through the development of alliances and partnerships. Conservation groups and their allies in government and the private sector have made good progress over the past 20 years in establishing parks and reserves to preserve terrestrial biodiversity. The scientific basis for defining these reserves, and managing and linking them, has grown more sophisticated. The number and variety of partners supporting these efforts has grown as well. Coastal and marine reserves need to catch up. Strong partnerships among conservation groups, government, the private sector, and local communities will be essential.

- ❖ Enhance coastal and nearshore water quality through partnership programs to control both point and non-point sources of marine pollution, while addressing the impact of the growing number of coastal megacities. There has been little meaningful engagement in a significant way with the challenges of coastal resource management in the context of megacities. This is a huge challenge that needs to be confronted for reasons of human welfare and environmental quality.
- ❖ Reduce the vulnerability of coastal populations and their infrastructure to the growing threat of flooding, storm surge, and coastal erosion due to climate change and rising sea levels. Mitigation efforts are essential. A great deal remains to be done that has not yet been done. But serious—even drastic—efforts in mitigation do not eliminate the need to undertake, simultaneously, ambitious initiatives in adaptation because sea level rise and other effects of global climate change seem inevitable.

What is next? Clearly, coastal and freshwater management challenges and needs will not abate in the foreseeable future. World leaders reaffirmed at the 2002 World Summit on Sustainable Development in Johannesburg the central role that these resource issues will continue to play in the sustainable development agenda. USAID is in full agreement with that affirmation and remains committed to full engagement on these issues.