40 Intergovernmental and International Aquatic Ecological Programs: Approaches for Successful Implementation

Jordan Dixon FLGC 1697 3rd article Needs to be scanned in

Stuart W. McKenzie

Programs involving intergovernmental and/or international cooperation must have certain characteristics to be successful. Several tangible ingredients are needed to accomplish ecological assessments that involve multiple governments and agencies:

- knowledge of hydrologic principles,
- knowledge of ecological principles, and
- knowledge of, and agreement on, issues that should be addressed.

For any program there also are intangibles such as trust, recognition, willingness, and commitment. Current developing intergovernmental programs are used to illustrate some of these tangible and intangible ingredients.

ISSUES FACING INTERGOVERNMENTAL WATER PROGRAMS

Intergovernmental and international programs exist that assess, from an ecological perspective, the water resources in many geographic areas of the world. Their continued existence requires that all participating groups agree on issues that warrant the expenditure of resources (money, time, and attention). The following common issues might be thought of as mutual principles:

- Minimum quantities of water are necessary to meet identified beneficial uses. Until these minimum quantities of water are available, considerations of water quality are secondary.
- Water identified for more than one use at a location should ideally be of a quality sufficient for all uses. For example, it is desirable for a drinking-water supply to have minimal taste and odor, whereas a cold-water fishery supported by the same source needs low temperatures and high dissolved oxygen concentrations.
- Uniform water quality standards should be adopted among political units. Such a policy leads to other "good neighbor" policies and promotes interstate activities. This is particularly true when surface and groundwaters move from one political unit to another and are used by both political units. Although the need for cooperation might seem logical, the desire to control our own destiny makes us reluctant to change our standards to be in agreement with our neighbor.
- Local management of river basins and watersheds should be allowed; however, such small- or local-scale management can lead to different water quality standards for adjacent watersheds. Because of the recognized importance of the nonpoint source contri-

0-56670-138-4/97/$0.00+$.50

bution of many contaminants, the need for watershed, community, and small-area management of land-use activities and waterways is critical to most successful programs.
- Multiple organizations would benefit by sharing data of known quality. Data of unknown or variable quality can lead to multiple conclusions and misunderstandings. Data from all organizations need to be supported by compatible protocols and quality-control data that are readily available and that document the quality of the data. The most common reasons that groups do not use existing water quality data are: (1) their inability to obtain these data in an efficient and timely manner, and (2) deficiencies of the data base(s) that make identification of the quality of the data therein impossible (Intergovernmental Task Force on Monitoring Water Quality, 1992).

ECOLOGICAL PRINCIPLES AND THE MANAGEMENT OF WATER RESOURCES

Water-resource managers have an opportunity to manage and impact our environment in a more ecological manner today than ever before; however, to take advantage of this opportunity, governmental agencies must cooperate to align their water and terrestrial programs if environmental management is to succeed. The opportunity now exists because of a better understanding of the science of ecology and advances in scientific technology in general. Whereas hydrologists and water-resource managers were once concerned only with the source, cause, transport, and fate of chemicals within watersheds and hydrologic cycles, today they need to consider the effects of the resulting water quality on aquatic biota and to infer the quality of water from the presence or absence of those biota.

The evolving science of ecology has identified scientific principles that are important to resource managers:

- Bacteria exists in soils at high concentrations and are effective at breaking down organic material. In the soil, most detrital organic material is broken down into inorganic chemicals that become dissolved in water, de-gas to the atmosphere, or sorb to soil particles that may be transported to water bodies. These bacteria enhance soil fertility which allows us to grow crops year after year in the same field. In the soil, many synthetic chemicals (pesticides) are broken down into nontoxic substances. For example, the herbicide atrazine will break down in a few days in the soil, whereas when dissolved atrazine is transported to a reservoir and held for 6 to 9 months, it is essentially preserved and will leave the reservoir in concentrations similar to those when it entered (Goolsby et al., 1993).
- Water used in the laboratory is purified by the distillation process to rid it of dissolved inorganic constituents. Nature has a similar process called the hydrologic cycle, which is composed of evaporation, transpiration, and precipitation. This natural still, operated over the Earth and powered by the Sun, produces most of our fresh water. We must fully understand this process if we are to manage our freshwater resource efficiently and effectively.

Advances in scientific technology and knowledge of ecological principles have had significant impacts on ecological assessments, resource managers, and water quality regulators in the following ways:

- Advances in analytical chemistry have paralleled developments in ecology. Analytical instrumentation is now capable of producing lower detection levels, cheaper analyses, and a better awareness of new and complex findings in our environment.

- The development of the computer has been critical to our ability to store and analyze the large amounts of data collected in the last two decades. Computers allow us to store and retrieve large amounts of data efficiently and to be responsive to data requests in a timely manner. Computers also have allowed us to develop methods for analyzing data using models and statistics which are effective tools for today's scientists and policymakers. Information is now being shared beyond the dreams of our parents. The Internet gives the public, researchers, data managers, and policymakers access to very large data sets.
- The understanding and misunderstanding of ecology causes the public to demand that managers of our natural resources think, regulate, and manage ecologically so that our children and grandchildren will be able to have water of good quality and experience the same vistas and habitats as we do now. An example of a program born of this concern is the President's Forest Management Conference in Portland, OR, where President Clinton brought resource managers, environmental groups, industrialists, and scientists together to establish a policy of ecological management for our national forest lands. Carefully crafted, such a policy would provide the wood-products industry with their necessary resources, allow the public to enjoy the recreational attributes of forest land, and preserve natural habitats and clean water for future generations.

HYDROLOGIC ISSUES CAN BE BENEFICIALLY ADDRESSED BY INTERGOVERNMENTAL WATER PROGRAMS

Many issues related to hydrology, sources of contaminants, and uses of water are amenable to cooperative efforts between agencies that collect data and those that manage the natural resource. In the U.S., our Congress, State Legislatures, and Tribal Councils are asking the government workforce to be more efficient by using fewer resources to accomplish more difficult tasks over larger geographic areas. This reduction in force is the opportune time to integrate programs confronting common issues that no longer have support and that cannot be achieved by a single agency. First, however, the identification of these issues must come from universities, research organizations, and other groups that collect, analyze, and interpret data. Water issues can be identified by their temporal and spatial variability, downstream transport, airborne transport, and use.

Temporal and Spatial Variability

There is no such thing as a steady state or homogeneity in nature. The measurement of the variability and interrelation of water quality and ecological parameters can be time consuming and expensive. Therefore, because there are limited resources to identify water quality problems, we must carefully consider both temporal and spatial variability in program design and in the optimization of sampling.

The existence of temporal variability in hydrologic data is well recognized. Examples include 24-hr variability of air and water temperatures, solar radiation, dissolved oxygen concentrations, and pH in water; local variability in flows, turbidity, and rate of water use; seasonal patterns of flow, water temperature, aquatic growth, and water use; long-term cycles (multiple years) of precipitation and drought; and long-term trends resulting from land-use changes, such as conversion of land use from agricultural to urban activities.

Examples of temporal patterns include pesticide application at specific times to control insects and noxious weeds, resulting in detectable pesticide concentrations in waterways; seasonal storms that cause soils to erode, resulting in highly turbid streams; and the presence of benthic invertebrates of sufficient maturity to result in correct species identification. There are also seasons when aquatic organisms are more sensitive to environmental conditions, such as during spawning and rearing of anadromous fish, when high dissolved oxygen concentrations are important.

In addition to varying in time, water quality conditions can vary spatially. Local natural characteristics either directly or indirectly control the land-use and water-use activities of an area. Examples of natural characteristics include geology, topography, groundwater and surface-water availability, soil fertility and drainage, precipitation, and solar radiation. The human activities that are influenced by these natural characteristics determine which contaminants might enter groundwater or surface water in a particular area.

Downstream Transport

An important hydrologic issue that affects downstream water users in a watershed, but that involves upstream water users as well, is downstream transport. For every action that occurs upstream, there is some response downstream. Things placed in a stream will move downstream, and if the rights to using water of acceptable quality and quantity are to be protected for all users in a watershed, responsibility must be accepted by all the water users in the basin. This is one of the primary reasons why management of water resources on a local level, such as a river basin or watershed level, is more likely to be successful.

Airborne-Contaminant Transport

The transport of airborne contaminants is an issue that is not directly related to watershed and hydrologic principles but is nonetheless a hydrologic issue. The principle is the same as for downstream transport, but the medium is air instead of water. Several examples of impacts on water and vegetation that are the result of the downwind contamination by point and nonpoint sources can be cited:

- Nitrates in Sierra Nevada snow that are downwind of Los Angeles and San Francisco.
- Acid rain and sulfates in water bodies that are downwind of large industrial and urban areas where high sulfur coals are burned, such as in the midwestern and eastern areas of the U.S. and Canada and in areas of Europe.
- Trace elements in snow downwind of a smelter in Tacoma, WA.
- Eradication of natural vegetation on a hillside downwind of an industry at Luke, MD.

Water Use

Efficient and equitable use of water for agricultural, urban, and industrial activities is important because of the limited availability of high-quality water. Not all uses are equal, and where water is used, the quality often has been altered. Examples include the following:

- Use of water to cool a thermoelectric plant will cause the temperature of a stream or estuary to rise, will adversely affect fish habitat, but will consume very little of the resource.
- Use of water for irrigation consumes from 25 to 90% of the water diverted from streams or pumped from wells; return flows typically carry suspended sediment, pesticides, and nutrients.
- Mining activities can place sediment in streams, disrupt habitat, and place toxic contaminants in surface and groundwater, streambed sediment, and aquatic tissue.

Generally, sufficient funds are not available in Federal, State, Tribal, or County treasuries to police all watershed activities. River basin and watershed or community acceptance of water use and water quality goals will be much greater if program coordination is on a watershed level.

EXAMPLES OF INEFFECITVE (BUT IMPROVING) INTERGOVERNMENTAL WATER PROGRAMS

The U.S. has policies that encourage the development of natural resources in the western states, including the harvest of trees from watersheds managed by the U.S. Forest Service and the Bureau of Land Management. This policy has resulted in endangering several species (e.g., spotted owl, bull trout, and salmon), and has caused public concern. Environmental groups are demanding that federal agencies include in their forest management policy, the management of ecological health and long-term productivity of forest and habitats. This form of management, which is still developing avenues of communication, compatible data sets, and trust, requires cooperation among groups that often have been on opposite sides of policy issues; these groups include forest managers, environmentalists, State and Tribal representatives, industrial representatives, Federal and local regulators of water and wildlife, and the general public.

Canada has problems that are similar to those of the U.S. One of the difficulties for Environment Canada, as an agency that assesses and regulates water resources, is the delegation of responsibility to different independent agencies. The agency responsible for water quantity often does not have to coordinate with the agency responsible for water quality. While the management responsibility for surface-water quantity and quality is in the federal sector (Environment Canada), Provincial governments are responsible for groundwater. Coordination and collaboration are still possible but require goodwill by all participants. With no overriding agency or policy to see that progress will be made when conflict occurs, changes are often slow to nonexistent. Recent reorganization of Environment Canada is trying to correct some of these problems.

Historical discharge records for the Jordan River in Jordan are available for only up to when Israel took control of the West Bank of Jordan. Since that time, no discharge records for the Jordan River have been available to the Jordanian government. The need for placing the collection of acceptable scientific information within the policies of both countries has been missing. Recently, a greater acceptance of common goals within policies of both governments has emerged that could lead to a change of environmental goals.

Russia and countries of the former Soviet Union have a history of strong central governments, including those during the rule of the Czars, and later, the Communists. In the past political environment, fragmentation of responsibility to collect and assess water-resource data was not a problem because there was an overriding regulatory responsibility by a higher authority. Today, however, the strong central government is absent, and individual agencies from different countries are having to learn how to work in coordination and collaboration with each other. Because of the limited funding in support of these public agencies, progress is often very slow. Natural resources will likely be the loser because of the lack of good data and coordinated management. Recently, assistance by the World Bank has provided an opportunity for several agencies responsible for the drinking water supply for Moscow to work together to revise the water-quality monitoring program.

DESIRABLE COMPONENTS OF ENVIRONMENT-BASED INTERGOVERNMENTAL WATER PROGRAMS

WORKING AGREEMENTS

To be most effective, intergovernmental working agreements must include Federal, State, Tribal, and local public agencies as well as private and voluntary organizations. This is particularly true when managing a river basin or watershed. All the "stakeholders" that use or are affected by the use of the resource must be willing to agree on the management of the resources and support the effort (new taxes, new regulations and restrictions, promotions of goals of preserving and improving the resources).

Monitoring Programs with Identified Goals

In order for monitoring programs to have the data necessary to assess environmental conditions, there must be a recognition of the desired goals and specific questions to be answered. Often times a data-collection program is started, the data are never interpreted, the program is never revised, and when questions are asked, the data needed to answer the questions are not available. There are very logical and rational ways of developing monitoring programs. An American Society for Testing and Materials method for designing monitoring programs has been developed. To use water-quality monitoring programs that are not well planned wastes public money and breaks down confidence in the public management of our resources.

Quality Assurance Plans

We must be able to use each other's data with confidence and to accomplish this the data must be collected according to (1) protocols that are accepted by all, (2) techniques and methods that are compatible, and (3) quality-control data guidelines that provide an acceptable measure of the quality of the data. These three preceding items describe a quality-assurance plan. The National Water-Quality Monitoring Council is currently working to identify compatible sample collection methods and performance-based analytical methods that will make up a usable quality-assurance plan (Intergovernmental Task Force on Monitoring Water Quality, Technical Appendixes I, N, and O, 1995a).

Environmental Indicators and Data Sets

Cooperating public agencies and private organizations need to identify the required environmental indicators and specify the minimal amount of data needed to answer their agreed on questions. This is particularly true of ecological programs where different agencies have specific responsibilities. It is critical that all agencies work together and share their data for a complete assessment to be successful. A minimal data set includes date, time, location, and the measured constituent value. Ideally, the data should be located in a system that can easily be accessed and geographically portrayed. New geographic information systems (GIS) are capable of handling data in this manner.

Data Storage and Transfer

Data storage is a critical part of any water program. Characteristics of a modern data-collection program ideally should include the reliable storage of relational data (including the listing of protocols, analytical methods, and quality-control data), the efficient and timely transfer of data when requested, and the frequent update and maintenance of the data by the agency or organizations collecting the data. The transfer of data among agencies would be made easier if the agencies that collect and store data would use software that is mutually compatible and would develop programs to facilitate the transfer of data between computers (Intergovernmental Task Force on Monitoring Water Quality, Technical Appendix M, 1995b).

Interpretation and Communication

Interpretive tools (models and statistical programs) and communication skills are needed to turn data into information and make it understood by managers and the public. Interpretation is often done by universities, research institutes, consulting firms, and public agencies. The computer has significantly enhanced our ability to interpret data through the development of mathematical models, nonparametric statistical packages, time-trend analyses, and GIS software. We must still inform the managers and the public of the results in an understandable and timely manner if the results are to be meaningful. The day of writing a 50 to 100 page technical report to display on a library shelf is over. We need layreader reports to facilitate communication among technical experts, lay managers, and the public. Examples of lay publications and their characteristics are listed in the Intergovernmental Task Force on Monitoring Water Quality report (Technical Appendix K, 1995c).

INTANGIBLE INGREDIENTS FOR SUCCESSFUL INTERGOVERNMENTAL WATER PROGRAMS

Finally, intangible ingredients must be present for intergovernmental water programs to succeed. These include:

- The establishment of trust among the participants. This trust often comes from working together, and in time, the credibility of an organization would be recognized by other organizations.
- The recognition that the goal can be accomplished only by working together. Indeed, the economic savings may be so great that the advantage of cooperation would be self evident. Or, a higher organization can recognize the need and direct the cooperation.
- A willingness of each agency and organization to accept the responsibility for its actions and to risk making decisions; some of which almost surely will be contested by the public and (or) some of the participants.
- A commitment that the scientific integrity of the program will not be compromised to accommodate political objectives.

These intangibles are basic to successful intergovernmental assessments and management programs. Decisions need to be made by the heads of agencies before any movement toward cooperation can begin. Even then, there is a tremendous bureaucratic weight to shift before cooperation and collaboration will occur in a meaningful way.

The alternative to heads of agencies causing change is for the emphasis to come from the grassroots level. Certainly, the most likely route to success (causing a change) is from a watershed area perspective; stream basins and watershed boards need more encouragement. However, large river basins will be left out because of their size; the Columbia River Basin and perhaps the Willamette River Basin are in this category. Water-resource agencies in a river basin must have sufficient monetary resources, often related to population and (or) industrial activity, to fund the needed data collection, assessments, and structural and nonstructural changes necessary to improve existing environmental conditions. Watershed boards could, however, cause bureaucracy to react if they presented a unified front.

EXAMPLES OF EFFECTIVE WATER PROGRAMS ON THE WATERSHED AND RIVER BASIN LEVELS

The Nooksack Watershed Project was started in 1994 and has stakeholder participation in the form of agriculture, businesses, environmental groups, fisheries, recreational interests, water utilities, and representatives of local, state, tribal, and federal agencies. The Nooksack Basin, located in Northwest Washington, covers 1250 mi^2, has over 1000 miles of rivers and streams, and has a population of 143,000. The project deals with the issue of limited streamflow throughout the basin and water-quality problems in the forested, rural lowlands, and urban areas. For example, 33 water bodies do not meet Federal water quality standards at this time. The effort to change these conditions has started with the inception of the project (Richard Grout, Washington Department of Ecology, written commun., 1996).

The McKenzie Watershed Study in Oregon was started in 1991 by two local agencies seeking ways to resolve existing issues. They have collected all the existing water quantity and water quality data and have begun monitoring key locations. There are 20 members on their council representing federal, state, city, county, utility, parks and recreation, agricultural industry, timber industry, environmental groups, and local neighborhoods. The four issues that they currently deal with, of 50 that were identified, include (1) water quality conditions, (2) fish and wildlife habitat, (3) recreation, and (4) human habitat. One unique aspect of the McKenzie Study is that the effort has been carried out by volunteers (Laurie Power, McKenzie Watershed Council, oral commun., February 1996).

The St. Croix River Basin is 7700 mi^2 in drainage area in Minnesota and Wisconsin, has 134 dams on 1770 tributary streams, and has 624 open lakes. One hundred ten species of fish have been identified in the basin. In 1992, the heads of the St. Croix Riverways Office, the Minnesota and Wisconsin Departments of Natural Resources, and the Minnesota Pollution Control Agency agreed "to provide for the coordination of the planning and implementation of measures to protect and improve the water quality in the St. Croix River Basin" (Minnesota-Wisconsin Boundary Area Commission, 1996). The plan of study was completed in 1993 by the St. Croix River Basin Team, composed of member representatives and representatives from the Minnesota-Wisconsin Boundary Area Commission, University of Minnesota, and the U.S. Geological Survey. Two issues being addressed by the team in the basin include (1) How much phosphorus reduction is needed to protect Lake St. Croix? and (2) How much mercury reduction is needed (and over what timeline) to eliminate fish consumption advisories in the St. Croix River?

The Delaware River Basin Commission, formed in 1961, oversees a compact among Pennsylvania, New York, New Jersey, and Delaware, and the Federal Government. Funding for the compact is from these five members. The commission has strong management powers for resolving problems between states, including issues related to drought flows, storage and release of water from reservoirs, and maintaining sufficient flow to keep the salt wedge downstream of the recharge area in the lower Delaware Basin. The Commission has been active in cleaning up and controlling municipal and industrial sources of contaminants, starting in 1968, using guidelines now known as Total Maximum Daily Loads. Recently, the Commission has been working to establish uniform criteria and acceptance of common waste load allocation methods for the river. The Commission has also been active in securing special classification for drinking water supplies and for some waters to prevent further degradation (David Pollison, Delaware River Basin Commission, oral commun., February 1996).

REFERENCES

Goolsby, D. A., Battaglin, W. A., Fallon, J. D., Aga, D. S., Koplin, D. W., and Therman, E. M., Persistence of herbicides in selected reservoirs in the Midwestern United States — Some preliminary results, in *Selected Papers on Agricultural Chemicals in Water Resources of the Midcontinental United States*, Goolsby, D. A., Boyer, L. L., and Mallard, G. E., Eds., U.S. Geological Survey Open-File Report 93-418, 1993, 51.

Intergovernmental Task Force on Monitoring Water Quality, Ambient water-quality monitoring in the United States: First year review, evaluation, and recommendations: Reston, VA, U.S. Geological Survey, 1992, 51.

Intergovernmental Task Force on Monitoring Water Quality, The national strategy for improving water-quality monitoring in the United States: Technical appendixes I, N, and O, Reston, VA, U.S. Geological Survey, 1995a, 59.

Intergovernmental Task Force on Monitoring Water Quality, The national strategy for improving water-quality monitoring in the United States: Technical appendix M, Reston, VA, U.S. Geological Survey, 1995b, 83.

Intergovernmental Task Force on Monitoring Water Quality, The national strategy for improving water-quality monitoring in the United States: Technical Appendix K, Reston, VA, U.S. Geological Survey, 1995c, 69.

Minnesota-Wisconsin Boundary Area Commission, St. Croix Stewards Journal, Fall 1995–Winter 1996, Hudson, WI, 1996, 14.