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SUSTAINABLE MANAGEMENT OF THE OHIO RIVER (USA) BY AN INTERJURISDICTIONALLY REPRESENTED COMMISSION

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ABSTRACT

In 1948 the Ohio River Valley Water Sanitation Commission (ORSANCO) was established to abate pollution of a major river basin in the United States. The commission consists of representatives of eight states in the Ohio River Valley and the United States Government. The necessity of such an interstate commission, representing multiple jurisdictions, reflects the nature of the Ohio River which is approximately 1,580 km in length, transverses six states, and is extensively used for public and industrial water supply, wastewater disposal, transportation, power generation and recreation. ORSANCO's programmes include co-ordination and communication, setting and enforcing wastewater discharge standards, operating key water quality monitoring programmes for the Ohio River and major tributaries, data assessments and studies to evaluate problems and programmes for remediation, and monitoring when spills occur. The Commission's approach to achieving improved water quality, while at the same time balancing the needs of the users of the river, is accomplished by successfully involving and integrating the various interests in river management (governmental agencies, industry, public utilities, other river users and the general public) into its programme planning and implementation. Thus an intergovernmental agency which encourages co-operation with non-governmental entities can be an effective approach to sustainable management of a major river.

KEYWORDS

Intergovernmental Agency; water quality; water quality management; river basin pollution control.

INTRODUCTION

Sixty years ago, the Ohio River was frequently described as an "open sewer". In fact, it was reported in 1930 that during a drought, the flow in the river was so low that some of the pools formed by the navigational dams became virtually "open cesspools". At the same time, there was a succession of epidemics of gastro-enteritis along the river and in the valley. The first outbreak occurred in Charleston, West Virginia, in 1930, with an estimated 4,000 to 7,000 cases among the city's 60,000 inhabitants. Other cities along the river experienced similar outbreaks. These outbreaks were believed to have been caused by the contaminated condition of the river; fortunately, there were no reported deaths.

Only a few of the urban centres along the river were sewered at that time. Of the sewered population, less than one percent was served with any form of treatment facility. The pollutional load contributed by

Cincinnati, Ohio (1930 population, 450,000) was particularly distressing. To emphasize the point, someone creatively calculated that Cincinnati's daily pollutional load was equivalent to "720 dead horses", and that this amounted to the discharge of one dead horse every two minutes.

A number of states along the Ohio River had laws at that time which discouraged pollution control. For example, the State of Ohio had a law that no river community could provide sewage treatment until such time as all upstream communities provided treatment. Thus no Ohio community would be expected to treat its sewage until all river communities in Pennsylvania did so.

Given this situation in the early 1930s, the public, including civic and business leaders, recognized that in order to improve public health and economic development, action was required to improve the water quality of the river. Further, it was clear such action by a single state would not solve the problem; a regional approach was needed.

In response to this interest, the US Congress in 1936 authorized and directed the states within the Ohio River Valley to negotiate an agreement or compact to abate pollution in the basin. The process of negotiating a compact among the states turned out to be a most difficult task, principally because this was an untried mechanism for establishing regional co-operation for the control of water pollution. It was not until 12 years later that a compact among the several states was established.

This compact, authorized by the Federal Government through the US Congress, ratified by the legislatures of eight states and signed by the Governor of each state, created the Ohio River Valley Water Sanitation Commission (ORSANCO) in 1948. The eight signatory states to the compact are: Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Virginia and West Virginia.

Among the specific charges given to ORSANCO in the compact are to:

- conduct surveys and studies of the basin to identify water pollution problems and develop programmes for their control;
- Develop recommended legislation for adoption by the individual states to address pollution problems;
- Develop, as necessary, standards for the treatment of wastewater discharged to the Ohio River and those tributaries that form boundaries between states or flow from one state to another.

In addition to these charges, the compact, which has not been changed in its 47-year history, provides ORSANCO with the authority to enforce its adopted wastewater discharge standards utilizing the U.S. court system. Thus, ORSANCO is an interstate agency with regulatory and enforcement authority for improving and maintaining interstate water quality.

The compact provides that the commission consist of 27 members, three representatives or commissioners from each signatory state and three commissioners representing the Federal Government. The federal representatives are appointed by the President. The state representatives are either appointed by their respective governor or serve as *ex-officio* members by virtue of their position as head of the state's environmental protection or water pollution control programme.

Integral to the commission's operation is its committee structure. This includes standing committees consisting of commissioners, advisory committees made up of representatives of specific outside interests, and special committees. It is through these committees that the commission receives inputs from a variety of river interests and is thereby able to consider competing demands on the river's resources in setting its policies. This approach to river management, while requiring considerable time and effort in policy development, ensures results that are acceptable to all interests. The process leads to a sustainable level of river utilization and protection.

The commission convenes three times a year to conduct business and establish policies and programmes to carry out the objectives of the compact. The commission's headquarters are in Cincinnati where a full-time staff of 17 is responsible for carrying out the established policies and programmes.

The commission's operating budget is supported proportionately by the eight member states, taking into account their population and land area in the drainage basin. For 1994 the total budget was approximately $1.9 million (US) of which $940,000 was provided by the states; $370,000 came from the Federal Government through the US Environmental Protection Agency; and the remainder was provided from various public and private sources to undertake special projects.

DESCRIPTION OF THE OHIO RIVER

The Ohio River is formed at Pittsburgh, Pennsylvania at the confluence of the Allegheny and Monongahela Rivers, and flows 1,580km in a generally southwest direction to join the Mississippi River near Cairo, Illinois. The first 60km of the river are within Pennsylvania; the remaining 1,520km form the state boundary between Ohio, Indiana and Illinois to the north and West Virginia and Kentucky to the south of the river. The drainage basin totals 525,000km^2, or about five percent of the contiguous United States (Fig. 1).

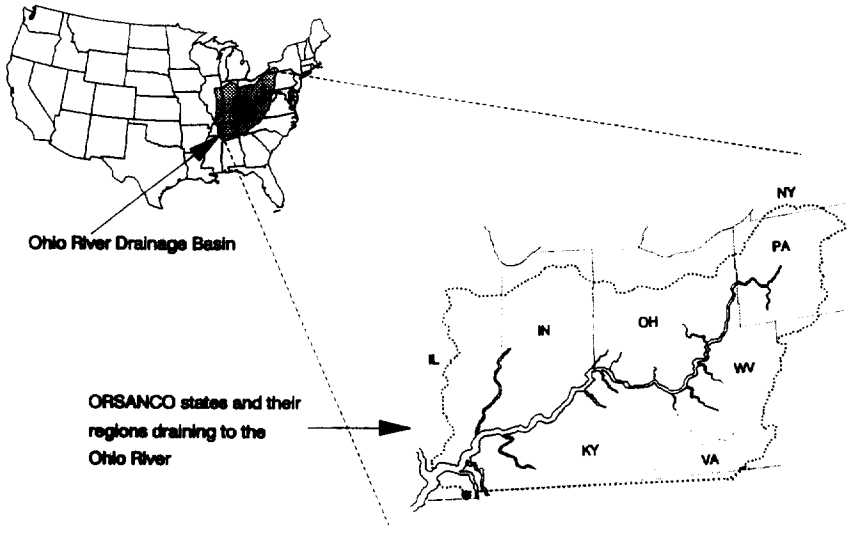

Figure 1. Ohio River drainage basin and Orsanco states.

The flow in the river is regulated by a series of locks and dams operated and maintained by the US Army Corps of Engineers. The 20 dams on the river create a series of pools. Depending on location, the flow in the river averages 990 to 7,080 cubic metres per second (CMS).

Today approximately 21 million people (or almost 10 percent of the US population) reside in the basin within the eight member states of ORSANCO. The river is a water supply source for nearly three million people.

Of the total 194 municipal wastewater treatment facilities discharging directly to the Ohio River, 126 have flows of 150m^3 per day or greater; these 126 facilities serve 3.5 million people. The major discharges of treated municipal wastewater are at Pittsburgh, Cincinnati and Louisville.

There is also a variety of industrial discharges to the river, including steel, chemical and power production. Of the total 383 industrial discharges, 114 are contaminated process discharges with flows of 150m^3 per day

or greater. There are 44 electric power-generating facilities on the river which collectively produce approximately six percent of the nation's installed generating capacity.

The river is also a major artery for the transportation of industrial materials. Currently over 200 million metric tons of cargo are transported through barge traffic, a significant portion of which is petroleum and hazardous chemicals.

In addition, because of improved water quality, the river is being used more and more for such recreational activities as boating, water skiing and fishing. This has brought about growth in the recreational and tourism sectors of the valley's economy.

THE PROGRAMMES OF ORSANCO

The current activities of ORSANCO may be classified into five general categories. All five areas involve a strong interrelationship between local, state, and federal governments, public utilities, industries and the general public.

Water quality monitoring

Valid data on water quality conditions of the river are essential to the efforts of the commission and its member states in carrying out the provisions of the compact. In order to obtain such data in a cost-effective and consistent manner, the commission is responsible for monitoring the river and the lower reaches of its tributaries.

Through the commission's committee structure, representatives of the states and other interest groups have input in determining the scope of the commission's monitoring programmes.

Certain monitoring programmes involve sample collection by ORSANCO personnel with analyses being performed by contract laboratories, while other programmes involve the compilation of water quality data generated by other agencies and organizations. Three basic monitoring programmes are:

Manual Collection of Samples. Programmes consist of bimonthly collection of samples at 30 fixed stations, of which 16 are located on the main stem of the river and 14 on the lower reaches of the major tributaries. Analyses are performed for 32 constituents/properties, including the conventional pollutants, heavy metals, cyanide and phenolics. In addition, recreation season (May-October) sampling to determine bacterial levels is undertaken at seven stations below urban areas. At least five samples are analyzed per month at each station.

Organics Detection System. This programme, established in 1978, involves daily sampling at 15 water utilities and industries along the river and certain major tributaries. Each sample is analyzed for 22 volatile organic compounds using gas chromatography. The results of this monitoring programme are integral to the commission's spill response programmes.

Biological Sampling. The Commission has conducted or co-ordinated multi-agency studies on fish populations and tissue quality annually since 1968 and now supplements these studies with analyses of macro-invertebrates.

Samples of fish are currently acquired by electrofishing. Results of analysis of fish tissue for selected pesticides and other contaminants known to biomagnify/bioconcentrate are provided to state agencies to support the issuance of consumption advisories.

The commission also conducts special studies as necessary to address emerging concerns. Such studies usually involve co-operative efforts with two or more of the member states.

In addition to being a source of water quality and biological data for the various state and federal agencies, these monitoring programmes provide the database which is the source of information, or the "back-bone" for a number of different but related programmes of the commission.

Wastewater discharge standard setting and enforcement

The commission maintains wastewater discharge standards for the Ohio River. The formulation of these standards involves joint discussion among representatives of the states and other interests within the framework of the commission's committee structure. After public hearings and adoption, it is the responsibility of the individual state agencies, in consonance with their commitment to the compact, to oversee the application of the standards within their state.

Because the states have been effective in applying the commission's adopted standards, ORSANCO's independent enforcement powers have been utilized infrequently. The commission prefers to work through or with its member states or the federal government in enforcement matters.

For example, it became evident in 1985 that the major point source of pollution to the river was the $5.7 m^3$ per second discharge from a particular wastewater treatment plant. Because of a number of problems, this secondary treatment plant was not performing adequately so as to meet its effluent discharge limitations or ORSANCO's standards.

As a result, the commission joined with the regulatory agency of the appropriate state and the US Environmental Protection Agency in a court order which required that the treatment plant achieve compliance with established effluent limitations by July 1988. After spending over $110 million on a remedial construction programme to improve its secondary treatment, sludge handling and disposal, and disinfection facilities, the plant achieved compliance on schedule.

Abatement of combined sewer overflow impacts

Because over 10 percent of the combined sewer overflow structures in the United States are located along the Ohio River, in 1992 the commission defined its role as a national leader in an effort to address abatement of water quality impacts from these sources. Among the specific actions of ORSANCO are the co-ordination of established abatement strategies of the states, technology transfer, co-ordination of adjacent community impact studies, and development of science to support management decisions.

Water quality assessment

The commission staff reviews its ambient water quality monitoring data for validity and evaluates the data for any transgressions of the established water quality criteria. If a water quality problem is evident, a study is implemented to determine the cause(s) of the impairment so that a remedial programme can be established. Attention is given to the impact of both point and nonpoint sources as well as to tributaries. These assessments permit evaluations of: progress; the relative magnitude of the causes of water quality impairment remaining; and the effectiveness of the current control efforts.

Spill response

Proper reporting of and response to spills and accidental discharges to the Ohio River and its tributaries has also long been a major concern of the commission. Any spill to the Ohio River or its tributaries has potential interstate impact and can disrupt water supplies.

The commission serves as the central point of communication when spills occur to ensure that affected states and downstream water utilities are promptly notified. This is accomplished through a network communication system, including an electronic bulletin board for the rapid dissemination of information.

In addition to co-ordinating communication, the commission staff provides estimates of instream concentrations and time-of-travel of the spilled material and, if deemed necessary, initiates an emergency instream monitoring programme. To cite one particular incident, a major spill occurred on January 2, 1988 on the Monongahela River, 32km upstream of Pittsburgh. This spill was of unprecedented magnitude and character insofar as the inland waters of the US are concerned.

In this spill, a 14,400m^3 storage tank collapsed, releasing approximately 2,650m^3 of diesel fuel to the river. Attempts to contain the oil using surface booms were only partially successful. The commission was notified and the staff immediately responded by co-ordinating efforts to track the oil spill's movement down the river and providing information to state and federal agencies, water supply utilities and the public.

For tracking the movement of the oil spill downriver, it was determined that boat-mounted fluorometric measurement would give the most rapid results. Analyses were performed to determine the daily location of the frontal edge, peak and trailing edge of the spill (Fig. 2). This information permitted the water supply utilities withdrawing water from the river to know the time of arrival and passage of the spill so that appropriate protective measures might be taken.

Based on the information provided by ORSANCO, water supply utilities handled the problem in a variety of ways. Some simply closed their intakes and turned to alternative sources of water during the period that their systems would be impacted. In some cases, barges filled with water from tributaries not affected by the spill were utilized as supply sources for small communities. Some utilities adjusted their treatment by increasing their coagulant dosage and/or by adding activated carbon during that period when the oil spill was passing their intake.

Besides the problems associated with water supplies, the oil spill had a severe impact on aquatic life. It was estimated that over 10,000 fish were killed downstream of the site of the spill.

WATER QUALITY IMPROVEMENTS

In the early years of ORSANCO, control of pollution from municipal wastewater discharges through the construction of primary treatment plants was a priority. In 1970 the commission promulgated standards requiring secondary treatment of all municipal wastewaters and equivalent treatment for industrial discharges. Table 1 shows the percentage of the sewered population along the Ohio River served by secondary treatment between 1972 and 1990.

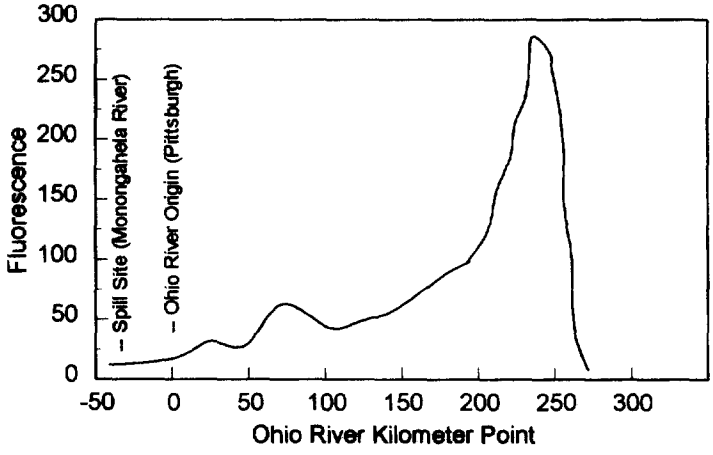

Figure 2. Profile of diesel fuel in the Ohio River (16 January 1988, 14 days following spill).

Table 1. Municipal wastewater treatment plant discharges to the Ohio River: sewered population vs. secondary treatment

Year	Total Sewered Population	Sewered Population with Secondary Treatment	Percent Population with Secondary Treatment
1972	3,575,000	71,000	2.0
1982	3,587,000	2,995,000	85.3
1990	3,597,000	3,575,000	99.1

As a result of enhanced municipal and industrial wastewater treatment, the quality of water in the Ohio River has improved over the years. This is evident from the dissolved oxygen (DO) levels, which have increased at most locations along the river. In comparing the DO levels at various locations during the similar low flow conditions caused by the droughts of 1965 and 1988, it was found that the DO concentration in the river was, with few exceptions, significantly higher in 1988 than in 1965.

Correlating with the improvements in DO levels, fish population studies indicate a balanced population today throughout the Ohio River, including many pollution sensitive species. There has been a 40 percent increase in the diversity of the fish population over the past 13 years. For example, the sauger (a desirable pan fish) returned to the lower reaches of the river beginning in 1968. Today it is well established throughout most of the river. Because of improved water quality and the associated improvement in the biological community, sport fishing today is a very popular activity along the river. Boating and water skiing on the river are also increasingly popular.

ORSANCO recently completed a trend analysis of a number of chemical constituents important in assessing water quality improvements in the river. For example, there has been a gradual decrease in the concentration of ammonia in the river since 1977 (Fig. 3). Similar decreasing trends were documented for six other constituents commonly associated with wastewater discharges, namely lead, phenolics, total phosphorus, total kjeldahl nitrogen, copper and zinc.

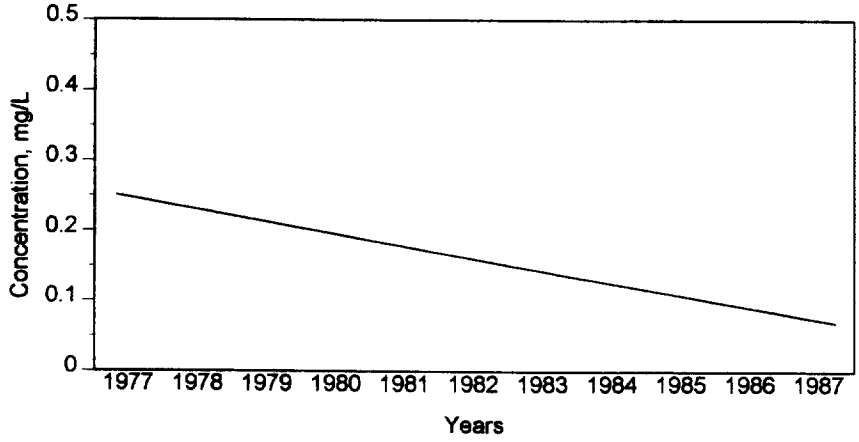

Figure 3. Trend of Total Ammonia Concentration in the Ohio River at Gallipolis, OH (kilometre point 449.3).

CONCLUSIONS

Over ORSANCO's 47-year history, the water quality of the Ohio River has improved significantly. The commission's effectiveness may be specifically attributed to the following:

The commission is vested with statutory authority to establish unified standards for the treatment of wastewaters and to enforce the standards.

The individual commissioners of ORSANCO are appointed by the highest governmental authorities, i.e. the governors of the various states and the President of the United States.

ORSANCO acts as the agency through which the states can negotiate and agree on programmes for pollution control. For those programmes carried out by the states, the commission facilitates co-ordination and information exchange. The commission implements certain other programmes itself, e.g. water quality monitoring, thereby eliminating or minimising duplication of effort, inconsistencies in data collection, interpretation and assessment.

The commission effectively integrates input of various interests affected by its programmes, including industries, utilities and the public, through its sponsorship of advisory committees. As a result, the commission enjoys widespread support.

Because of the broad authority of the compact, the organizational nature of the commission, and its separate but adjunct relationship to the various state water quality control agencies, ORSANCO can react swiftly to meet changing conditions and challenges affecting water pollution control.

ORSANCO is a model to be considered elsewhere for effective water quality management. In the case of a river basin transcending states, provinces, regions or nations, a commission such as ORSANCO, representing multiple jurisdictions, can be an effective mechanism for achieving the co-ordination and communication essential to abate water pollution while at the same time allowing sustainable development.