

WORKING PAPER

NEGOTIATED RIVER BASIN MANAGEMENT
IMPLEMENTING THE DANUBE DECLARATION

Joanne Linnerooth

January 1988
WP-88-4

NOT FOR QUOTATION
WITHOUT PERMISSION
OF THE AUTHOR

**NEGOTIATED RIVER BASIN MANAGEMENT
IMPLEMENTING THE DANUBE DECLARATION**

Joanne Linnerooth

January 1988
WP-88-4

Working Papers are interim reports on work of the International Institute for Applied Systems Analysis and have received only limited review. Views or opinions expressed herein do not necessarily represent those of the Institute or of its National Member Organizations.

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

PREFACE

During the past few years there has been a growing international concern about environmental and socio-economic impacts and conflicts associated with the use of transboundary water resources in general, and also with the use of international rivers in particular. The *Decision Support Systems for Managing Large International Rivers Project* (LIR) was launched at IIASA to address at least some of the crucial issues regarding the management of large international rivers. The project aims to provide methodological and technical assistance towards collaborative efforts of countries, river basin commissions and international agencies. Its scope is vast involving research in many fields, including political sciences.

The author presents an extensive and interesting analysis of problems of the Danube, which is one of the two case studies being dealt with in LIR. The other case study is the Zambezi River in Africa. The approach is rather unfamiliar to professionals of physical and technological problems in

shared river basins. It does not mean that this work is not for such professionals, on the contrary, for the facts and mechanisms described by Linerooth should rather help in establishing cooperation in improving the water quality of the Danube. We hope that this work will lead to constructive discussions that are necessary not only in the case of the Danube to establish mechanisms and organisations to improve and harmonize the utilization of water resources in shared river basins.

K.A. Salewicz

Project Leader

NEGOTIATED RIVER BASIN MANAGEMENT

Implementing the Danube Declaration

*Joanne Linnerooth**

I. INTRODUCTION

Following in the wake of the Chernobyl nuclear accident, the recent catastrophic poisoning of the Rhine river stunned the European public with an awareness of its vulnerability to the risks of even distant technologies. Technological accidents, along with such problems as acid rain, ozone depletion, and even soil pollution, are increasingly of international concern. Yet, international procedures and institutions for coping with transboundary environmental problems are only just beginning to evolve. Current arrangements and mechanisms for transboundary environmental dispute resolution and cooperation will need substantial improvement if the environmental challenges of the next decades are to be met.

In many respects, the management of surface water has been a forerunner in international cooperation on a shared resource. This unique history of cooperation, however, has concerned mainly the economic development of water resources; the problems of water quality and ecological degradation have generally not enjoyed the same status. There are discouragingly few multinational working arrangements for preventing water pollution. The Rhine river disaster, for which no river in the world can claim immunity, has dramatized the urgency of multinational efforts to prevent the further degradation of valuable water resources.

* This paper was supported by a grant from the Carnegie Foundation to the IIASA project on the Processes of International Negotiations (PIN). I am grateful for the helpful comments and assistance I received from W.C. Clark, Acad. Z. Kaczmarek, G. Kovacs, D.P. Loucks, L. Mermet and E. Weber. I take, however, full responsibility for all views expressed in this paper.

This paper is concerned with the management of one of the most international rivers in the world --- the Danube. Recently, representatives from eight European countries bordering the Danube have declared their willingness to cooperate on its management, especially in confronting the mounting problems of water pollution. In signing this non-binding Danube Declaration (1985), the riparian countries have moved slowly, but squarely, into what White (1977) has called the integrated approach to river management. Accordingly, greater attention is paid to making informed tradeoffs on the conflicting uses of a river and particularly to the interrelationships between its biological and physical properties and other environmental systems.

Understanding the tradeoffs involved in setting priorities on the conflicting uses of the Danube presents a challenge to the scientific disciplines traditionally engaged in water research. An equally difficult challenge, as the history of over 200 international river basins shows, lies in establishing cooperation between sovereign states in the management of a shared water resource. This challenge can be appreciated by considering that the implementation of the Danube Declaration requires cooperation:

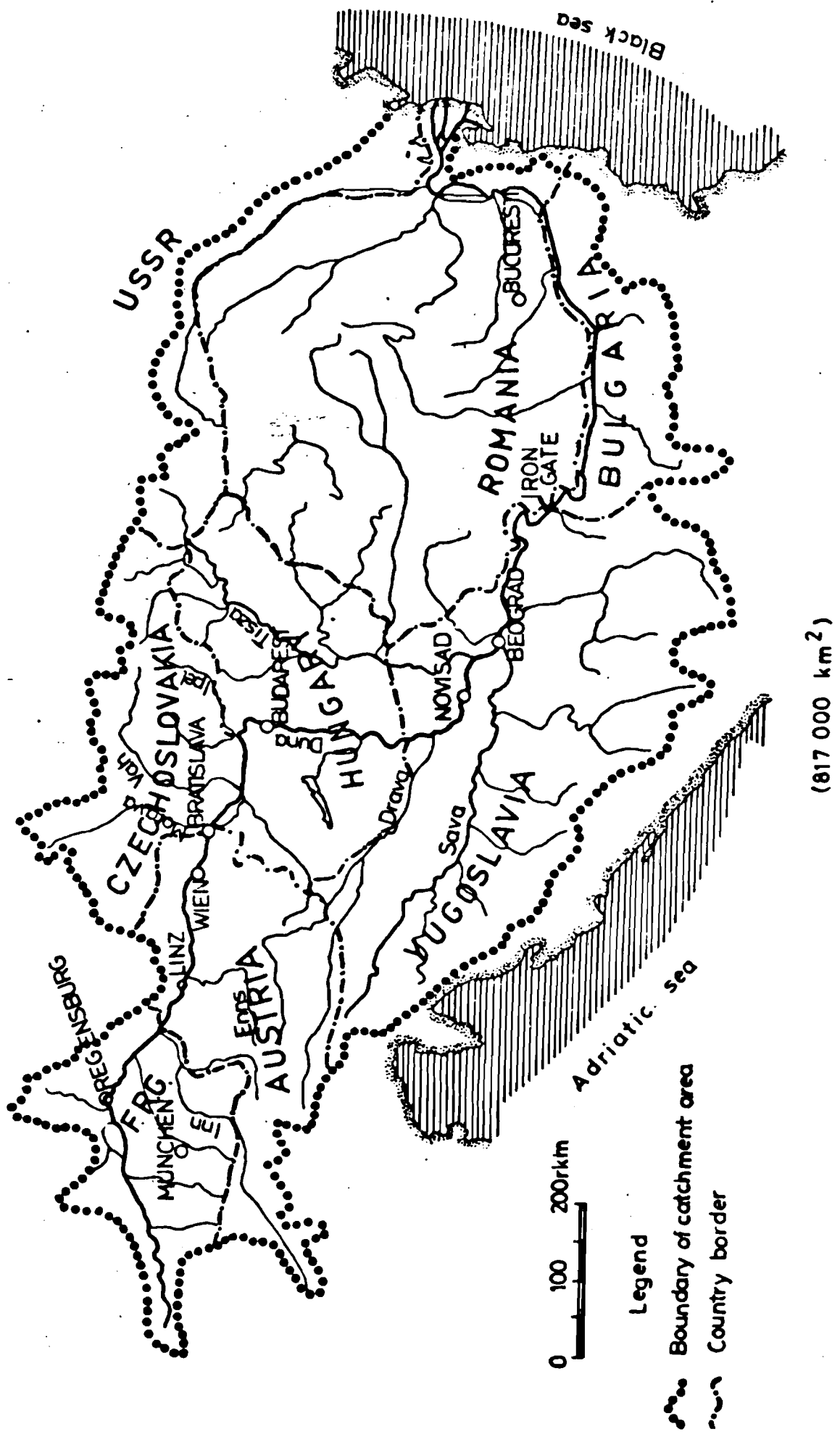
- among eight countries spanning Eastern and Western Europe;
- in the absence of effective and enforceable international legal rules;
- in the absence of a basin-wide planning or decision authority for the integrated management of the river;
- between numerous national and international authorities with diverse, conflicting interests;
- on problems for which the geopolitics of the "upstream" and "downstream" countries creates disincentives for cooperative behavior;
- on issues characterized by serious scientific gaps and uncertainties; and
- in an atmosphere of increasing concern about the long-term effects of toxic pollutants and an acute awareness that pollutants cross national boundaries.

An underlying theme of negotiation research is that significant improvements in cooperative problem solving and negotiated policy making are possible. These improvements are crucial for coping with worsening transboundary environmental problems. This paper describes the water quality issue on the Danube as, foremost, a problem of negotiated settlements, and explores the potential of the analyst in this process.

After briefly describing the geography of the Danube river and the nature of the conflicts involved in its management, I turn in Sections III and IV to the issue of water pollution. The scientific gaps in understanding the pathways and effects of toxic water pollutants and the "upstream-downstream" geopolitics of cooperative regulation combine to make this issue especially difficult from the perspective of negotiated policies. In Section V, I examine the intricacies of the negotiating process, which in the absence of a Danube river basin authority will involve mostly bilateral agreements with all the accompanying intrastate and inter-organization hurdles in reaching internal consensus. These internal negotiations have the potential of becoming even more difficult as the Danube pollution issue is escalated onto the public agenda as part of rising public concern over accidental and chronic water pollution, which may be aggravated by the continuing exploitation of Danube water power. In section VI, I turn to the potential role of the analyst in supporting negotiations on the shared use of water resources by furthering mutual learning and joint problem solving.

II. THE DANUBE RIVER

Flowing over 2,850 km. from the Black Forest in the Federal Republic of Germany to the Black Sea in Romania and the USSR, the Danube is Europe's second largest river (see Figure 1). It is also one of the world's most international rivers with eight riparian countries, including the FRG, Austria, Czechoslovakia, Hungary, Yugoslavia, Romania, Bulgaria, and the Soviet Union, and it transfers water from the non-riparian countries of



(817 000 km²)

Fig. 1. Catchment area of the Danube river WHO/1976

Albania, Italy, Switzerland and Poland. Near its source, the Danube has the character of a mountain river flowing through the FRG and Austria (passing Regensburg and Vienna) into Czechoslovakia, where at Bratislava it forms the border between Czechoslovakia and Hungary. Flowing south through the Great Hungarian Plain (passing Budapest), it turns eastward into Yugoslavia (passing Belgrad) and later forms the border between Yugoslavia and Romania with the famous narrows at the Iron Gate. The lower, marshy section of the river serves again as a geographic boundary on the long stretch between Romania and Bulgaria, where shortly before the Black Sea it separates Romania and the Soviet Union, and empties into a spectacular delta. Over 300 tributaries flow into the Danube.

The geographic variety of the Danube is matched by the cultural, economic, and political diversity of the countries through which it flows. Connecting Eastern and Western Europe, its joint management symbolizes the potential for cooperation between diverse political and economic cultures. Table I shows the different economic and Danube-related alignments of the eight riparian countries. In addition, two U.N. organizations, the Economic Commission of Europe and the World Health Organization, have been active in matters related to the Danube.

<i>Country</i>	<i>Economic</i>				<i>Danube-related</i>	
	EEC	EFTA	OECD	CMEA	BT	DC
FRG	X		X		X	Obs
Austria		X	X		X	X
Yugoslavia			Obs	Obs	X	X
CSSR				X	X	X
Bulgaria				X	X	X
Romania				X	X	X
Hungary				X	X	X
USSR				X	X	X

DC = Danube Commission

BT = Bratislava Treaty 1955

Diverse, conflicting uses of a large river

Possibly no other natural resource has so many uses as a river. To provide for this diversity, the management of this resource must assure, to varying degrees, the following fundamental interests:

- Maintaining the river flow
(for electric power generation and for the disposal of industrial and urban wastes)
- Maintaining and expanding the navigable waterways
(for navigation)
- Assuring an adequate supply of water
(for irrigation, industrial cooling processes, and all other uses)
- Protecting the water quality
(for potable water, irrigation, fishing, recreation, tourism, and nature preservation)
- Preventing floods
(for all uses)
- Preserving the river and its surroundings
(for recreation, tourism, and nature preservation)

Any management strategy will involve tradeoffs. The most difficult involve the uses of a river for such purposes as electric power generation, navigation, and waste disposal and those uses requiring an acceptable quality of water, e.g., potable water, irrigation, fisheries, tourism, etc. In addition, irrigation requires enormous quantities of water and may seriously reduce the supply of water for other purposes.

Historically, international river disputes have involved mainly conflicts over water apportionment, e.g., diverting the water for industrial and agricultural uses by the upstream countries and depriving those downstream of adequate supplies. The financing and control of flood prevention projects, with both advantages and disadvantages for downstream riparians, has been another contentious area, but also an issue that has presented opportunities for the cooperative management of rivers. Cooperation has been established in many river basins to promote large and multipurpose development projects, to increase the supply of water, prevent wide-scale flooding, produce electric energy and improve navigation. This cooperation on river development projects, however, has gen-

erally not evolved into mutual programs for combatting water pollution and assuring the environmental quality of the river basin. This conflict between the large-scale development of a river and its surroundings (with accompanying pollution problems) and the protection of the water quality and the environment is increasingly the basis of international disputes.¹

Issues of water apportionment and flood control have not shaken the Danube countries to the extent that they have characterized the political development of many other river basins. The water supply of the Danube is not significantly exploited for agricultural purposes. Although a great deal of water is used for industrial purposes,² much of this water is released back into the water supply and, therefore, only the quality of the water is affected and not the supply. Flood control has mostly occupied national governments, with a few important exceptions, e.g. on the Tisza river (Hungary and the USSR) and the Prut river (Romania and USSR).³

Major Danube issues and conflicts

The principle Danube issues that have provided a foundation for negotiated treaty making and institution building have concerned navigation and electric power generation. The geography of the Danube has presented arduous obstacles to navigation, including large shallow stretches, hazardous rapids, severe ice in the winter and heavy floods after the spring thaws. The long-standing Danube Commission has been instrumental in remedying most of these obstacles and has served as a forum for negotiating disputes mainly concerning the financing of the necessary investments.

¹Because of the huge areas affected and the sheer scale of some proposed developments, the long-distance, inter-basin transfers of water have evoked particular concern over the nature and scope of environmental changes. For instances, intense scientific and public debates have arisen over such proposals as shunting water from the Alaskan rivers through Canada and into the western United States, or the (abandoned) Soviet project for turning the Siberian rivers southward into Central Asia (Teclaff, 1978).

²In the U.S., e.g., industry accounts for over 40 percent of overall water consumption (Biswas, 1983).

³Flood control is potentially an area of international dispute on the Danube since the past and current trend in building levies as opposed to flood plains increases the intensity of the flooding in downstream countries (Wood, 1975).

Despite substantial investments for assuring its navigability, the Danube is still not a major waterway in comparison with other European rivers.⁴ The international importance of the Danube, however, may radically change with the completion of the Rhine-Maine-Danube canal which, by connecting the Atlantic Ocean with the Black Sea, will allow ships to cross Eastern and Western Europe. This canal is the final link of a long-standing plan to create an interconnected system of inland waterways in Europe.⁵ Its critics have protested its possible negative effects on Danube water quality resulting from the increased chances of accidental spills of hazardous substances due to the expanding traffic on the river (Benedek, et. al., 1978).

The mountainous character of the Danube in its upper reaches and the large number of tributaries further downstream combine to make the energy potential of the river significant. This potential has largely, though not fully, been exploited. There are 49 planned or existing hydropower stations on the Danube, 40 of which are located in the FRG and Austria. These 40 power stations are matched in energy output by the two enormous Iron Gate stations between Yugoslavia and Romania (Benedek and Laszlo, 1980).

The huge Iron Gate project is one of several examples of collaboration between two riparian countries in developing the joint water resource. Another collaborative project is underway for improving the navigable channel along the shallow stretch between Czechoslovakia and Hungary, and for the construction of two hydropower stations at Gabcikovo and Nagymaros. A third country, Austria, may contribute substantially to

⁴Around 60 million tons of materials are transported annually on the Danube and its tributaries, compared, for example, with around 700 million tons transported on West European waterways (Linnerooth, 1985). The Yugoslavs transport the most goods on the Danube and its tributaries (~22 million tons/year) followed by the Soviets (~15 million tons/year), and the rest of the countries (~26 million tons/year).

⁵Its full cost (around 1 billion dollars) will be financed fully by the federal government of the FRG and the state government of Bavaria. This cost, it is estimated, will be recovered by the planned hydrostations on the canal and the use of water for irrigation, industrial and recreational purposes, and including the increased opportunities for German shipping. The Economic Commission of Europe has estimated that by the end of the 1980's, the traffic on the canal between Nurnburg and Regensburg will be approximately 14 million tons per year. (Rhein-Main-Donau Aktiengesellschaft München, Baubericht 1974, 8000 München 40, Leopoldstrasse 28, April 1975.)

financing the projects in return for imported electricity once the projects are completed. The Gabčíkovo-Nagymaros project, along with an abandoned plan to construct a hydropower station in a nature reserve in Austria, have come under heavy attack from environmental groups. They have cautioned against damaging the ecology of the river, destroying the wetlands of north-west Hungary, and adversely affecting the ground water. Mainly as a result of these projects, the development of the river has become a visible and controversial public issue in the upper and middle riparian countries.

Already in 1977, the WHO warned that pollution controls on the Danube were not adequate (WHO, 1977). The pollution problems are in some case worsening mainly as a result of the rapid economic development of the Danube basin and the accompanying increase in point and non-point pollution sources. As counter measures, at least for the organic pollution, many urban centers have or are constructing sewage treatment plants. Without further measures, the planned construction of barrages and hydropower stations may also have an effect on water quality.⁶

In sum, the expected rapid economic development in the Danube basin, the planned opening of the Rhine-Maine-Danube canal, and the continuing construction of barrages and hydropower stations will contribute to a change in Danube water quality, along with possibly other ecological consequences. The costs of this river water degradation as well as the benefits from the development of the Danube are not evenly distributed among the riparian countries. The more prosperous upper riparians depend on the Danube mostly for industrial and waste disposal purposes and benefit disproportionately from the water power potential; the less-developed lower riparians are more dependent on the river for drinking water, irrigation, fisheries, and a large tourist industry at the Black Sea. As a

⁶The issue whether barrages and hydropower stations contribute to worsening water pollution is controversial and not fully resolved within the scientific community. Barrages and dams block the flow of suspended particles which may then accumulate on some stretches of the river bed, providing a possible long-term reservoir of pollutants and influencing the water exchange between the ground water and the river. Moreover, they reduce the velocity of the river flow and, in this way, lessen its capacity for regeneration from organic pollution. This loss in oxygen may be compensated, however, by the increase of the water surface and by the aeration of the water at the barrages.

migration of these substances into water resources and their dispersion. According to an experienced water modeler, the concept of water quality is intrinsically dynamic and uncertain and the standard dispersion assumptions are often oversimplified ¹² (Beck, 1980, p. 214).

The environmental group perspective

Since water serves basic human needs, any serious reduction in its supply or quality is, in the words of Frey and Naff (1984) "a fighting matter, as many a range war in the United States has demonstrated" (p.76). Under conditions of severe shortage, water or "good quality water" becomes for many key actors a highly sensitized, zero-sum, public issue, and one with alarming potential for conflict.

The issue of Danube water quality is by no means a fighting matter! To the contrary, it has the status of a routine, regulatory problem in that it is moderately low-key and disaggregated among organizations.¹³ There are some indications, however, that it might evolve into a more contentious public issue involving citizen action and environmental groups. Just as the "toxic problem" has become a dominant issue in North America and in some European countries, there is also growing concern over toxic pollutants by environmental groups and the public of the Danube countries. The recent accidents resulting in toxic poisoning of the Rhine river have dramatically intensified this concern by focusing attention on problems of acute, toxic water pollution.

¹²Water pollution is not the only issue in river management characterized by large uncertainties. Scientific opinion differs widely on such topics as the effects of artificial reservoirs on a region's ground water, the extent to which flood protection, irrigation, and drainage change the fertility of the soil, the transport of pollutants in a river, including changes in the transport of sediment and the accumulation of silt from water works, the efficiency of filtering techniques for drinking water, the possibility and implications of long-term fluctuations in water supply, and generally the prediction of environmental consequences of water development.

¹³See Lowi (1984).

IV. UPSTREAM-DOWNSTREAM DISPUTES

Effective cooperation for managing the Danube, and especially for coping with transfrontier water pollution, will rest ultimately on establishing the conditions and incentives for this cooperation. These conditions are frustrated by the "upstream-downstream" geopolitics of international rivers, where the upper riparians have distinct advantages in such policy areas as flood control, apportionment of water supplies, and especially river water contamination. The bargaining chips of the downstream countries may be limited to such areas as granting navigation rights or contributing to joint hydro-power projects.

If negotiation is characterized as an interactive process by which two or more parties or countries seek cooperatively to do better than they would have otherwise, then their alternatives to negotiation determine in some sense their negotiating power (Lax and Sebenius, 1985). It follows that negotiations can be most productive when this power is evenly distributed or when all parties are capable of contributing to a common good (or reducing a common bad) without which each would equally suffer (gain). When these conditions are lacking, such as in the "upstream-downstream" situation, then one can speak of power asymmetry (Zartman, 1985). One (or more) parties likes things the way they are and the other (or others) wants to change them. Those who want changes do not have the means to provide incentives to those interested in maintaining the status quo. Negotiations can be stymied when there appear to be no possibilities for trade, or when one or more of the parties is reluctant or unwilling to negotiate.

This asymmetry appears particularly troubling for the Danube river. As upper riparians, the FRG, Austria, and Czechoslovakia have less direct interest in improving water quality (the proportion of water in these countries used for drinking, irrigation, fisheries and tourism is less than for the countries further downstream), and have further advantages as well. With the exception of Northern Hungary and the Iron Gate region, the energy potential of the Danube is found mainly in the upstream countries, which are

also more industrialized than many of their downstream neighbors and thus potentially have more chronic and accidental discharges into the water. As for navigation, the CMEA countries' interests in an unrestricted navigation route to the Atlantic are at least as great as the Western European interests in an unrestricted Eastern route. In sum, there appear to be weaker incentives for the upper Danube riparians to cooperate with those further downstream. Alternatively, the downstream countries, with their large fisheries, tourist industry, and greater dependence on the Danube for potable water and irrigation, have a great deal to gain by cooperative policies, especially regarding water quality. In the opinion of the secretary of the Vienna-based International Society for Danube Research, the problems presented by the upstream-downstream politics are more formidable for multilateral cooperation than the problems presented by the East-West politics (Weber, 1986).

The issue of "upstream-downstream" is not, however, so clear as it may at first appear. Each of the Danube riparian countries lies both upstream and downstream on either the Danube or other rivers crossing its borders; each country has an internal interest in improving the water quality within its borders;¹⁴ and many new factors of joint interests (such as groundwater) are emerging. In the words of a former member of the Indus Commission:

...all riparian conflicts must be conditioned by the recognition that fresh-water diplomacy is a symbol and the test for the fundamental features of international relations: how to balance national interest (the domestic demands which go with availability of water and the emotion which goes with notions of territorial sovereignty) and the uncontrollable imperatives of international interdependence. We now have new factors which underline that "beggar the neighbor" approach, and ignoring the logic of integral unity of river basin and common stakes in the optimal progress of upper and lower riparian partners, is self-destructive. Ecology and groundwater potential which do not respect political frontiers and do not necessarily give advantage to the upper riparians are compulsive new considerations. (Mehta, 1986, p. 23)

¹⁴The most upstream riparian, the FRG, has one of the best reputations in the overall management of its rivers.

Even recognizing these emerging, compulsive new factors, inter-basin cooperation will continue to encompass issue areas, such as water pollution, characterized by unequal negotiating power. Their solution will presuppose the existence of "political will" on the part of the basin states. Since the real financial costs of measures such as pollution control may be substantial, and since national sovereignty is inevitably compromised through international cooperation, some compensating advantage or incentive to the upper riparian states is a prerequisite for cooperation.

The need for incentives is reinforced by the rudimentary and relatively ineffectual state of international law as a means of regulating water issues. Traditionally, four theories governing the use of international rivers have been advocated: (1) the Harmon Doctrine which advocates absolute sovereignty to upper riparians; (2) absolute territorial integrity which guarantees the lower riparians the use of the river in an unaltered state; (3) drainage basin development which stresses mutual development of a river's waters by all riparian states; and, (4) the equitable utilization theory, or limited territorial sovereignty, which permits use of a river's waters to the extent of doing no harm to other riparian countries (Le Marquand, 1978). This latter principle of "reasonable and equitable" utilization of water resources¹⁵ has now been established by such distinguished bodies as the International Law Association and International Law Commission of the United Nations. These principles and guidelines are not, however, binding law and are not backed up by agreed-upon legal structures for settling international water disputes (Caponera, 1985). Moreover, these principles are only just evolving to deal directly with transboundary water pollution.

¹⁵The equitable utilization theory has become the most widely advocated, not only by the international legal community, but also as evidenced by treaties, judicial decisions, academics and international bodies (Utton, 1983).

Linkages

With the lack of effective international rules, and when one or more of the negotiating partners lacks incentives to agree, broadening the negotiating agenda or linking even disparate issues may increase the bargaining potential of all countries. Even between countries where there are few explicit tradeoffs, one country may wish to build up a "reservoir of good will" to draw upon in future dealings. The potential of problem linkages in resolving long-standing stalemates was seen in a case involving the Colorado river, where the United States as the upstream country finally agreed to build a costly desalination plant only after river pollution was linked to other problems between Mexico and the United States (Ganz, 1972). The long deadlocked negotiations were only fruitfully resumed when the salinity issue became critically important to relations between Mexico and the United States.

Whereas the theory of environmental (and other) linkages is attractive for reframing issues and facilitating bargaining, too little attention has been given to the institutional and procedural obstacles for putting theory into practice. Environmental policy making has become increasingly specialized and fragmented, reducing the possibilities for more wholistic approaches.¹⁶ Expanding the water quality negotiation agenda to include, say, controls for dealing with acid rain or even groundwater introduces a staggering degree of complexity into the process. From a procedural perspective, this may be possible only by moving the issue to a higher political level as was the case in the Mexico-United States negotiations.

A special kind of linkage involves monetary compensation or "side payments". While paying the polluting country to clean up violates the polluter-pays-principle, it may be the only route to promote the desired changes, as evidenced by the recent

¹⁶Le Marquand (1978) has shown that this fragmentation is also apparent within the foreign policy institutions which may be responsible for conducting the negotiations, but which are dependent on other government institutions (such as justice, finance, water resources, and environment) for technical expertise and resources. Without interference and direction from above, the foreign affairs department may be severely restricted in the policy options it can pursue.

proposal that the Netherlands and the FRG compensate France for the costly process changes necessary to reduce the salinity of the Rhine. Another type of linkage, which is relevant mainly for the developing world, is international loans and subsidies for river development. Mehta (1986) describes how the World Bank with its lure of development funds became an independent arbitrator in the negotiations leading to the Indus Water Treaty (1960), which is one of the few examples of successful negotiations on a major international river. LeMarquand (1986) describes a similar process of agreement on the Senegal river, where the perspective funds from the international community for its large-scale development served to mute much interstate conflict.

V. COOPERATION THROUGH BILATERAL, STEPWISE NEGOTIATIONS

Improving the water quality of the Danube through cooperative decision making will be seriously complicated by the power asymmetry between the upstream and downstream riparians and the scientifically complex and ill-defined nature of the water pollution issue. Cooperative policy making will also be hampered by the lack of an existing river basin regime for multilateral, integrated decision making on the Danube. This section describes the policy making process which will likely evolve in response to the formidable problems accompanying the implementation of the Danube Declaration.

In signing the non-binding Danube Declaration, ministers from the eight riparian countries declared that:

The governments of the Danube states will endeavor to solve, stepwise, through bilateral and multilateral agreements, the concrete problems of the Danube, especially with respect to its water quality, which is of life-giving importance to the Danube countries. (p. 1)

Of special interest is *how* the signing ministers of these eight countries intend to secure the cooperation necessary for dealing with the manifold issues of Danube water quality. In this regard, the above quote from the Danube Declaration is revealing, especially its

wording "to solve stepwise through bilateral and multilateral agreements". Any progress on combatting the pollution of the Danube will be made through narrowly focused, rather than integrated and more comprehensive agreements, between two or maybe clusters of countries. As expressed by a member of the Austrian-Czechoslovakian Border Commission, the non-binding Danube Declaration should be viewed primarily as a signal for the riparian countries to establish more encompassing bilateral agreements, particularly in addressing problems of water quality (Schmidt, 1986).

"Functional and participant" incrementalism appears, therefore, to be the explicit strategy envisaged by the signing ministers of the Danube Declaration. In this context, incrementalism means making progress by stages, or often *ad hoc* sequencing, related to Lindblom's (1959) seminal description of "disjointed incrementalism". As increasingly complex problems emerge on the international negotiating agenda, the political actors often muddle through with strategic blinders -- structuring the issues and bounding each subissue in such a way that it is reduced in its complexity (Linnerooth, 1984). Functional incrementalism, then, means that progress is made by partial rather than wholistic improvements. A counterpart to this functional incrementalism is the concept of participant incrementalism, where agreements are first negotiated only among the most receptive participants with the intention of adding to this core consensus through subsequent negotiations.

Bilateral and Multilateral Agreements: Participant Incrementalism

The Danube Declaration has set the stage for individual country initiatives in negotiating agreements with neighboring countries, in other words, for cooperation through bilateral or multilateral arrangements. This stands in contrast with the 20th century theme of basin-wide planning, where various forms of river basin commissions deal cooperatively on managing water resources common to more than one jurisdiction. There are many different types of river basin organizations with widely-different functions, rang-

ing from the integrated management of a drainage basin or watercourse system,¹⁷ the management of, e.g., a development project through a single-purpose commission,¹⁸ or the management of data and statistics.¹⁹ These institutions also differ regarding their respective powers and procedures. Of special interest here are some those commissions with explicit mandates to anticipate disputes between the riparians and to facilitate their resolution.²⁰ Helping resolve disputes is critically important, especially since there are few examples of multi-purpose commissions with significant decision-making power.²¹ According to Caponera (1985, p. 569-570)

National interests often prevail when shared resources have to be allocated, when priorities have to be established among different uses, and when decisions have to be enforced. Decision making on these issues seldom rests in a joint commission, committee, or like institution. More often, all relevant decisions are negotiated piecemeal and approved unanimously by all states concerned, whether separately or within a collegiate body. Institutionalized cooperation is more successful in preparing the necessary data for decision making.

Though practically nonexistent on the international level, there has been important experience with multi-purpose, integrated commissions for dealing with regional water problems on the national (federal) level, for example, the interstate river administrations existing in Argentina, Australia, Canada, the United States and India. The river basin concept has also spurred the emergence of a new type of regional institute, the valley authority, a trend which also became apparent at the international level in the sixties.²²

¹⁷For example, the Niger River Authority has the purpose of insuring an integrated development program for all Niger basin water resources and activities.

¹⁸For example, the Danube Commission has responsibility only for navigation.

¹⁹New institutional mechanisms in the form of joint permanent technical committees have recently been created in Southern Africa (Caponera, 1985). For the Danube, this function is filled, but only to some extent, by the International Association for Danube Research, itself a part of the International Society for Limnology. This inter-basin association carries out research on topics related to the chemical, biological and general life properties of the Danube, but does not do any policy related research. It would be of only limited value, thus, in advising on the priorities to be established for different uses and users of the river.

²⁰For example, the Niger River Commission was created among the nine riparian countries for planning, exchanging information, preparing recommended decisions to be taken by member governments, and *facilitating the settlement of disputes between the parties*. Also, the International Joint Commission (IJC) between Canada and the U.S. was originally created for preventing and settling water disputes.

²¹An exception may be the Senegal River Basin Management Organization (OMVS) with four riparian members which encourages and coordinates water resources development in the Senegal. The unanimous decisions of the Conference of the Council of Ministries of the OMVS automatically bind its member states (see Le Marquand, 1986).

²²In an analysis of federal experience with interstate authorities, Alheritiere (1978) shows that the idea of establishing a supranational, integrated, multi-purpose drainage basin commission is largely utopian, and

Besides facilitating the resolution of riparian disputes, another important function of a multinational, integrated organization is its potential for building transnational and transgovernmental coalitions to deal with multiple and imperfectly linked issues (Keohane and Nye, 1977). However, as Majone (1986) has argued with respect to global regulatory agencies, there may be serious conceptual and pragmatic problems with organizations responsible for coordinating policies with widely differing local causes and consequences, i.e. the high transaction costs involved and the reluctance of nations to sacrifice their sovereignty. Aside from the many advantages and disadvantages, it is unlikely that mini-governments with the power to legislate and implement river basin policies across national boundaries will emerge. The role of interboundary commissions in defining negotiating agendas, linking issues, and facilitating the negotiating process may, on the other hand, have considerable potential promise.

The political obstacles for creating a supra-national, river commission for the Danube, or even a multi-purpose commission with limited powers, are apparent from the history of the Danube Commission. This single-purpose Commission has been the most influential international organization dealing with the Danube, though only with responsibility for matters regarding navigation.²³ Resuscitated after the Second World War, it is a decidedly riparian institution, but where the FRG continues to have observer status only. In many respects the Commission may be considered a prototype for East-West cooperation in a narrowly-defined functional field (Pichler, 1973),²⁴ but this same cooperation is not likely to develop in areas outside of navigation.

may be unnecessary. Some of the more effective interstate policies have been set by commissions not dealing with the entire river basin or not having jurisdiction over all the uses of the river.

²³Currently, the Danube river is regulated by the Belgrad Convention of 1948 and by a series of special agreements. The Danube Commission deals with problems concerning the regulation of the Danube for navigation purposes, the maintenance of the navigable channels, regulations regarding signals, safety matters, etc., measures against the obstruction of channels with ice, taxes on ship traffic, development of the Danube fleet, improvement of navigation technology, development of industries and harbors, and general water management. It plays only a small role in energy projects and flood control.

²⁴The processes of the DC have been described as cumbersome and sometimes frustratingly slow - and its secretariat remains largely powerless; yet, it has functioned quite effectively as an instrument of East-West cooperation. The principle of unanimity has protected those in the minority from being forced into decisions to which they object and the search for a consensus has often resulted in constructive compromises.

As Pichler (1973) writes, it would have been natural for the highly-qualified and ever increasing membership of the Danube Commission to have expanded its authority from that of navigation to areas such as energy production and water planning. But this integrative process did not occur and for deliberate political reasons. The neutral and non-aligned countries, Austria and Yugoslavia, formed a blocking coalition preventing the USSR from expanding the influence of the Danube Commission, and thus its own influence, beyond that of navigation. According to Schmitter (1970) this was a predictable process of regional integration, where decisions of the commission were "encapsulated" rather than allowed to spill over into other areas.

What is clear from the history of the Danube Commission is that cooperation among the eight riparian countries on issues such as transfrontier water pollution will not be facilitated through the creation of a multi-purpose commission with the breadth to make politicized tradeoffs between the conflicting interests or uses of the river or even with the power to facilitate negotiations. A single-purpose commission for water quality monitoring and pollution control, as advocated by, e.g., Bendel and Laszlo (1980), also does not appear likely at the current time. In the absence of an international river basin authority, the most likely mechanism for achieving collaboration appears to be through mainly bilateral agreements. A look at Table II shows that, with only two exceptions, all agreements and treaties for the Danube tributaries and especially the border waters have been bilateral.

What this style of river management means, in contrast to an idealized multi-purpose, supra-national, basin-wide commission, is that joint decisions will be made through agreements involving complex procedures of international and intranational, pluralistic bargaining. In Austria, for example, authority for the Danube, both domestically and internationally, is spread among six federal government ministries and their

Table II. Some multilateral and bilateral agreements concerning the Danube (WHO, 1982).

<i>Year</i>	<i>Countries</i>	<i>Topic of agreement</i>
1948 (1960)	(Austria), Bulgaria CSSR, Hungary, Romania, Ukraine, USSR, Austria)	Danube Convention on navigation of Danube
1950	Hungary, USSR	Convention to prevent floods and regulate R. Tisza
1952	Romania, USSR	Convention to prevent floods and regulate R. Prut
1954	Austria, Yugoslavia	Convention concerning water economy questions relating to R. Drava
1954	Austria, Yugoslavia	Convention concerning water economy questions relating to R. Mura
1955	Romania, Yugoslavia	Agreement concerning control of frontier waters
1955	Hungary, Yugoslavia	Agreement concerning water economy
1956	Austria, Hungary	Treaty concerning water economy in frontier regions
1956	Albania, Yugoslavia	Agreement concerning water economy in frontier regions
1957	Hungary, Yugoslavia	Agreement concerning fishing in frontier waters
1957	Romania, USSR	Agreement extending R. Prut convention (1952) to Tisza, Suceava and Siret, and other frontier waters
1958	CSSR, Poland	Agreement concerning use of frontier water resources
1958	Bulgaria, Yugoslavia	Agreement concerning water economy
1959	Romania, USSR	Agreement extending R. Prut convention (1952) to Danube
1963	Romania, Yugoslavia	Agreement relating to navigation and power generation Iron Gates
1967	Austria, CSSR	Treaty relating to management of frontier waters
1969	Hungary, Romania	Convention relating to control of frontier waters
1971	Germany, FR, CSSR	Local (non-government) commission dealing with pollution and management of frontier waters

various service organizations.²⁵ The jurisdiction of these federal ministries ends with the Danube and border waters; responsibility for all other Austrian rivers rests with the Austrian provinces.²⁶ Environmental groups are also arriving on the scene with strong protests over the possible ecological and water quality consequences of the planned hydro-power stations in Austria as well as further downstream.

While the federal government in Austria has full control over the Danube, this is not the case for two neighboring countries, the FRG and the CSSR, where the respective state (Land) governments have the primary responsibility for all rivers within their territories. Hungary might be considered at the other extreme of Austria, since most of the competence for the Danube river is found in one central body, the National Water Authority.

Stepwise Agreements: Functional Incrementalism

The difficulties in coordinating measures and testing protocols for conventional water pollution and the huge number of proven and potentially toxic substances which find their way into water supplies underscores the need for regulatory attention to be selective. A comprehensive policy for water pollution with the many diverse sources and effects of hazardous pollutants would overwhelm any regulatory authority as well as efforts to negotiate a common policy between two or more countries. Setting boundaries on the negotiating agenda and proceeding stepwise through the intricacies of the problem will be essential.²⁷

²⁵The Ministry for Agriculture and Forestry has responsibility for the water quality of the Danube and frontier waters; whereas the Ministry of Health and Environment must assure safe drinking water. Hydroelectric and other projects must be approved by the Ministry for Construction and Technology, which has a special fund (Water Management Fund) for subsidizing sewage systems and water treatment plants. The Water Police (Strom Polizei), which are responsible for enforcing the navigation codes, are located within the Ministry for the Interior, whereas the Shipping Police (Schiffahrts Polizei), which assure that the channel is properly marked, etc., are part of the Ministry of Transportation. Coordinating water policies with other countries brings in another governmental authority, the Foreign Affairs Ministry.

²⁶This dispersed authority can lead to serious problems in coordination, for instance, if the Ministry for Agriculture and Forestry detects a change in the water quality of the Danube, it may find it difficult to track the source of the pollution to the tributaries which are outside its jurisdiction.

²⁷See Dowling and Linnerooth (1984) for a discussion of the political bounding of a similar issue, defining hazardous wastes.

As emphasized by the Danube Declaration, the first step in grappling with the manifold problems of improving Danube water quality is arriving at a common agreement on what water quality is and how it should be tested. This means harmonizing the many divergent testing protocols found on the Danube, a process which will meet all the definitional and administrative complications discussed in Section III.²⁸

*The Austrian-Czechoslovakian Agreement on Testing the
Water Quality of the Frontier Waters*

The workings of the Austrian-Czechoslovakian Border Commission,²⁹ and a recent agreement within this Commission on common definitions and testing protocols for measuring the water quality of the frontier waters,³⁰ presents a good example of the incremental (participant and functional) procedures set out in the Danube Declaration. This agreement, marking the first stage in the eventual improvement of Danube water quality, involved only two countries, and discussions were confined to a narrow concept of water quality. Besides oxygen content and biological indices, the measures included water pH, ammonia, nitrates and nitrites, phosphorus, chloride, calcium, magnesium, mineral oil, and the hardness of the water. The agreed-upon protocol did not include tests for heavy metals, pesticides, carcinogens, and other toxic substances found, for example, on the EC Black List. Despite its limited scope, it is valuable as a first step in reaching an overall basin-wide agreement on data collection for water quality measurements, and it may serve as a model for further riparian agreements (Schmidt, 1986). The way in which this agreement was reached, then, is of interest,

²⁸These obstacles to coordinating technical definitions and practices have been clearly illustrated by attempts on the part of the European Economic Community in harmonizing standards for water quality, which have met with resistance from countries with different administrative working definitions. For example, the U.K. has developed a philosophy of performance-based standards which is contrary to the EC's concept of uniform limit values (see Biggs, 1980).

²⁹See the Treaty Concerning the Regulation of Water Management Questions Relating to Frontier Waters, Dec. 7., 1967, Austria-Czechoslovakia, art. 314, 728 UNTS

³⁰Gemeinsame Methodik der Untersuchungen des Gütezustandes der Österreichisch-Tschechoslowakischen Grenzgewässer, 1986.

The loosely-knit Border Commission is composed of four commissioners from each country, representing separate federal ministries concerned with different aspects of water management. When problems concerning the border waters (e.g. regulation, flood control, water supply, etc.) come to their attention, usually a working group of experts from both countries is established which makes recommendations to the Commission. These recommendations are approved only with unanimous agreement among the eight commissioners. Once agreements are reached by the Commission, they must then be ratified by the respective federal Parliaments. Over a period of six years the Austrian and Czechoslovakian expert committee for establishing testing protocols met regularly and, with the eventual imposition of a deadline by the Commission, reached an agreement. Having agreed within the expert committee, approval by both the Border Commission and the respective national Parliaments was *pro forma*.³¹ This represents an example, then, of negotiation and decision by expert committee.

The question arises why there exists the current interest on the part of Austria and Czechoslovakia in coordinating policies leading eventually to an improvement in the quality of the frontier rivers, especially Austria's interest as the upstream country. The answer appears to lie in the long-standing concern on the part of both countries in improving the water quality of the badly polluted March, a river forming the border between Austria and CSSR and an important tributary to the Danube. This interest has become acute for both countries with the current plans to construct the Gabčíkovo-Nagymaros barrage and hydroelectric system which requires an improvement in the organic water quality of the Danube. For Austria, which plans to participate in the financing of this project and, in return, will receive electric power, the water quality issue has been linked with its interests in hydropower generation in the downstream countries.

³¹The Austrian Parliament has ratified the agreement (Oct, 1986) and Czechoslovakian ratification is expected shortly.

VI. OUTLOOK: A Role for the Analyst?

The signing ministers of the Danube Declaration have emphasized that a balanced management of the Danube river can be achieved only through cooperation among the eight riparian countries. Establishing this cooperation, especially on improving the water quality of the Danube, will be complicated by the power asymmetry between the upstream and downstream countries, the scientifically complex and ill-defined nature of the problem and the lack of an effective river basin authority for multilateral, integrated decision making on the Danube.

A more comprehensive and expedient program for tackling the problems of Danube water pollution is also limited by the inherent difficulties sovereign states face in negotiating environmental issues, generally. In a recent article, von Moltke (1987) questions whether sovereign states can speak for all interests within their jurisdiction, and particularly for the needs of environmental protection. Since environmental resources will likely not be assigned rights by international law in the foreseeable future, the most that can be hoped for is an enlargement of the circle of participants recognized as having legitimate interests and a right for participation in the international negotiations. Progress will not be rapid. International negotiating processes have adjusted slowly to the existence of non-governmental participants.

As a low key issue, progress on Danube water pollution will undoubtedly continue very slowly within the incremental procedures laid out in the Danube Declaration. Only as the issue becomes more urgent from the perspective of the scientific community and from the standpoint of the public can more expedient actions be anticipated, but only to the extent that these groups gain standing on the negotiating agenda. The public visibility of the Danube water pollution issue in the different riparian countries is therefore critical to the progress of negotiated solutions; this visibility will depend to a large extent on the economic development of the countries and the corresponding consciousness and concern about environmental problems on the part of the public and the scientific commu-

ity. At the present, this consciousness varies widely among the eight riparians.

A Role for the Analyst?

Even if Danube water quality emerges as an urgent public issue with corresponding pressures on international negotiators, difficult scientific issues, and equally perplexing institutional problems, will stand in the path of its resolution. With the complexity of both the scientific issues and the procedural mechanisms, analysts have become concerned about how they can be more effective, not only in identifying transfrontier environmental problems and alternatives for their solution, but also in providing support for negotiating international treaties and agreements for their resolution. The use of computerized support systems for aiding policy makers and negotiators has become especially topical.

A wide range of scientific opinion accompanies most environmental issues. In the case of the Danube, for example, there are serious conflicts concerning the effects of river development projects on the quality of the Danube water, the ground water, and the general ecology of the river basin. Many view the negotiation process, thus, as foremost an exercise in joint learning to reach common understandings and eventual solutions. An hypothesis underlying much of the literature on the use of computers to facilitate or aid negotiations is that information forms a neutral ground for agreement which can free the path for trading off legitimate differences in interests. Raiffa (1984), in noting the enormous scientific complexity in international environmental disputes, notes also the important question of the interrelation between facts and interests:

Negotiators must argue the merits of their cases, but they don't know the physical facts. There is a need for some mutual learning. How do they learn together and still protect their own interests? That is the beauty of the problem. (p.45)

This problem of learning together is fundamental to the use of computer support systems in aiding negotiations. In this section, I will briefly discuss the potential and limita-

tions of computer aided negotiations (CAN) for two distinctly different negotiation settings: (1) the "win-win" bargaining setting where all the parties perceive mutual gains in cooperative behavior, and (2) the more adversarial setting where the parties perceive more "win-lose" outcomes. The former can be likened to the routine negotiation of water quality testing between Austria and Czechoslovakia, whereas the latter is more representative of the water quality issue as it becomes enmeshed in the disputes involving environmental groups over the conflict between river development and ecological preservation of the river.

Mutual learning and "win-win" bargaining

Less adversarial, "win-win" negotiations are more receptive to joint learning and cooperative problem solving than disputes for which the advantages of arriving at mutual compromises are not so apparent. The most outstanding example of the use of the computer in a negotiation in which all parties perceived possible benefits was the U.N. Law of the Sea Conference (for a full account, see Sebenius, 1981). Because of its likeness to many international negotiations for river development, it deserves mention here.

The resolution of the problem of the deep sea mining of "manganese modules"³² became important for an international agreement on the common use of the oceans. Prior to the negotiations, the U.N. General Assembly declared the deep sea resources to be the "common heritage of mankind", and the task of the negotiations was to find a system for their equitable sharing. A conflict developed between the developing and developed countries concerning the profitability of deep sea-bed mining and how the proceeds from mining enterprises could be fairly distributed. After six years of intensive negotiations, a compromise agreement was reached by the over 140 countries, which appears to have been partly attributable to the joint exploration and learning made possible by a computer model developed at the Massachusetts Institute of Technology showing the

³²The modules are composed of commercially promising quantities of copper, cobalt, nickel, and manganese.

engineering and financial aspects of module recovery and processing.

Sebenius (1981) attributes the acceptance of the model largely to the properties of the model, itself, that established it as unbiased, objective, and credible.³³ Since similar examples of mutual learning and model acceptance are so few, and since all modeling efforts - the MIT model included - have an inherent, subjective component, it is important to look beyond the model to the conditions of the negotiations, themselves, which led to a willingness of the part of the delegates to find a consensus on the structure and analytics of the problem. One likely factor was the "win-win" nature of the negotiations, which gave a strong incentive for the delegates to resolve the distributive questions. Also the relative newness of the issue and accompanying lack of entrenched interests within countries made it easier for delegates to embrace an outside problem formulation. Without the overriding need to justify their positions in their own countries, the delegates had more flexibility to accept "neutral" evidence. Finally, the delegates represented, for the most part, government ministries, e.g. finance and foreign affairs, which means that in spite of their national differences they shared a certain professional rationality and thus a common overall frame of the issue.

Although on a more modest level, these same conditions exist in many negotiation forums, such as the bilateral expert committee appointed by the Austrian-Czechoslovakian Border Commission to work out an agreement on testing protocols for the quality of the border waters. The informal, side-by-side work of these expert committees allows flexibility for brainstorming and joint problem solving. Fisher (1986) has contrasted this style of negotiation with more formal, around-the-table diplomatic sessions, and has stressed the advantages of the reduced authority of advisory committees giving the members more freedom to explore interests and to invent options that might promote

³³According to Sebenius, several factors influenced the acceptance of the model: (1) the model was developed independently of the LOS Conference; (2) the model's early results fully pleased no delegation, confirming in some sense its neutrality; (3) the presentation of the model's results by the MIT groups highlighted the uncertainties, increasing further its credibility; and (4) the chairman of the financial group, who was highly respected by the delegates, strongly favored the use of the model.

shared concerns and accommodate those that differ (p. 138). Independent, outside expertise can then be brought in to aid the negotiations in much the same way as the MIT model was used in the LOS Conference.

In other words, limited-authority committees may provide fertile ground for the use of independently developed, interactive models to aid negotiators of water resources. These models will have a narrow perspective because of the usually narrowly-defined problems with which these committees deal. Loucks, et. al. (1985), in reviewing some thirty years of systems models in water resources management, conclude that the disappointing influence of comprehensive regional or basin-wide studies on negotiated policies can be attributed, in part, to the failure of these models to meet the narrower agendas and needs of the decision makers and negotiators. They applaud, thus, the apparent shift to the more project-oriented models addressing narrower issues:

Policy changes will continue to be incremental and, barring serious surprises, decisions will rarely be revolutionary. Hence, policy modelers and analysts should focus their problem and issue-oriented research on helping to guide these incremental changes. (p. 229)

Recognizing both the value of an integrated system in clarifying the complex tradeoffs at a more aggregated level, e.g. the relation between deforestation and river water quality, and the need of decision makers and negotiators to have narrower, more disaggregated information, Kovacs (1986) proposes a hierarchal system of decision support systems for managing large international rivers which can anticipate the expected consequences of policy options at various levels of decision making. For basin-wide planners, the model would give aggregated results which could be disaggregated for the types of decisions negotiated by, e.g., such bodies as Border Commissions.

Mutual Learning and Adversarial Negotiations

On February 8 of this year (1986), some 100 brave Hungarian and Austrian environmentalists attempted to march around Margaret Island in the middle of the Danube at Budapest. They were expressing their concern over the damage that they believe will result from the construction and operation of the proposed Gabčíkovo-Nagymaros hydroelectric system. This is an example of protests that have occurred much more frequently throughout the west -- protests over adverse impacts that are perceived will happen as a result of some proposed water resource development scheme. In fact, there is no shortage of disputes over issues involving water resources anywhere in the world. (Loucks and Salewicz, 1986, p.1)

Protests in Austria and Hungary over river development projects are only just emerging and signal a beginning interest of environmental groups in the Danube. These groups, however, have yet to gain standing on Danube negotiations. Still, with the emergence of such groups, analysts must confront the problems of dispute settlement. Loucks and Salewicz (1986) suggest a role for information sharing and mutual learning in negotiating a resolution to adversarial environmental disputes. Information sharing, in the form of interactive, decision or negotiation support, could facilitate more informed negotiations by, at least, focusing the debate on the assumptions and data.

Their advocacy of information systems as a way of facilitating multi-stakeholder disputes fails to account, however, for some fundamental differences between situations in which negotiation participants want to solve a common problem cooperatively from one in which (potentially hostile) parties view the outcomes more as zero-sum alternatives. Research in multiperson decision support systems (DSS) has mostly addressed the first situation where knowledge sharing and preference aggregation have been the main issues. The majority of these DSS systems have been employed in essentially a common problem or problem frame (Jarke, 1986). Neither of these assumptions are generally appropriate for more adversarial bargaining among groups with different perceptions of the problem and different logics or rationalities for dealing with it. For these situations, a fundamental shift will be necessary to orient negotiation support away from "information, analysis

and solution" to providing mechanisms for communicating, and maybe finding overlaps, on the different subjective representatives of the problem by the different actors.

In closing, it should be noted that this brief discussion has looked at only one aspect of the computer for providing negotiation support to promote mutual learning through flexible or interactive modeling. Many other promising opportunities exist, for example, in group modeling and gaming exercises which permit mutual generation and exploration of scenarios. Also, more game theoretic and decision analytic programs have been developed to help the group or facilitator explore outcomes in terms of the preferences and values of the negotiating partners. The use of the computer for aiding negotiations is an exciting new direction, but a direction which can benefit from a better understanding of the human, organizational, and political setting which ultimately determines the effectiveness of the computer as a negotiating tool.

VII. SUMMARY AND CONCLUDING REMARKS

The signing ministers of the Danube Declaration have emphasized that a balanced management of the Danube river can be achieved only through cooperation among the eight riparian countries. Establishing effective cooperation on improving the water quality of the Danube, which has been the focus of this paper, will be severely hampered by the power asymmetry between the upstream and downstream countries, the scientifically complex and ill-defined nature of the problem, the lack of an effective river basin regime for multilateral, integrated decision making on the Danube, and the slow and uneven emergence of public concern in the riparian countries.

Sovereign nations with upstream advantages will be reluctant to negotiate water quality improvements unless compensating benefits are an implicit or explicit part of the bargain. Harmonizing parameters and definitions of water quality, as a first step in its control, will be complicated by the scientific gaps in understanding the effects of water pollutants, especially toxic substances and their dispersion, as well as the divergent

national perceptions of the issue and resulting differences in definitions. Finally, the process, itself, superimposes another level of complexity. In the absence of any present or perspective inter-basin river authority to deal with water pollution, progress will be made only through a series of mostly bilateral agreements covering small, "bounded" segments of the problem, as illustrated by the recent bilateral agreement between Austria and Czechoslovakia on water quality parameters and testing protocols.

To the extent that Danube water pollution becomes a more visible public issue as a result of (1) an increased public awareness and concern over toxic pollutants, especially accidental releases, or (2) becoming enmeshed in the current controversies over Danube development projects, the process will need to accommodate the interests and views of environmental groups. This will dislodge the issue from the routine, administrative machinery of regulatory politics and place it in the broader, and more contentious, context of environmental and ecological preservation. As the issue changes form, new procedural mechanisms and different types of analytical expertise will be called upon in the process of negotiating cooperative policies.

The dynamics of the issue underscores the need for different types of analytical support depending on its form. As a low-key, regulatory issue and with an *a priori* agreement on definition, negotiation forums could be usefully served with narrowly defined support systems which facilitate mutual learning and problem solving. If the issue broadens both in terms of the problem and the stakeholders, then the concept of "mutual learning" becomes problematic. To be useful, negotiation support systems will have to accommodate plural problem definitions and rationalities which may be inconsistent with the rationality and logic of the system designer. The focus of multiparty negotiation support in an adversarial setting will, therefore, have to reorient from systems emphasizing shared information and analysis to systems which promote communication and mutual problem formulation.

As a final word, the importance of examining international mechanisms which have evolved for managing and negotiating water issues cannot be overemphasized. To date, nearly all forms of international cooperation with respect to shared resources have been in connection with surface water and aquatic resources. How problems and disputes over the shared uses of water resources have been negotiated and resolved, how past and present institutions have succeeded or failed, and the ways in which the analyst can contribute to the substantive and procedural issues, are questions of increasing concern if the world community is to cope with the expanding menu of transfrontier environmental problems.

References

- Alheritiere, D. (1985), Settlement of Public International Disputes on Shared Resources, Elements of a Comparative Study of International Instruments, *Natural Resources Journal*, 25, July, pp. 701-711.
- Beck, M.B. (1980), Modeling for Management, *River Pollution Control* (M.J. Stift, ed.) Ellis Horwood, p. 341-354.
- Benedek, P. and B. Hock (1980), Water Pollution Control on the River Danube, *River Pollution Control* (M.J. Stift, ed.) Ellis Horwood, p. 77-93.
- Benedek, P. and F. Laszlo (1980), A Large International River: The Danube, *Progress in Water Technology*, 13, 61-76.
- Benedek, P., P. Litherathy and L. Somlyody (1978), Monitoring and Modeling Efforts on the Large International River (Danube), *Progress in Water Technology*, 10, 147-162.
- Biggs, A.I. (1980), Quality Objectives and Fixed Emission Standards - an Industrial View, *River Pollution Control* (M.J. Stift, ed.) Ellis Horwood, p. 31-35.

- Biswas, A.K., A. Khan, and A. Nishat (1983), *River Basin Development*, Proceedings of the National Symposium on River Basin Development, 4-10 Dec., 1981, Dacca, Bangladesh, Tycooly International, Dublin.
- Caponera, D. (1985), Patterns of Cooperation in International Water Law: Principles and Institutions, *Natural Resources Journal*, 25, July, pp. 563-587.
- Deklaration über die Zusammenarbeit der Donaustaaten in Fragen der Wasser Wirtschaft der Donau, Insbesondere zum Schutz des Donauwassers gegen Verschmutzung, (1985), Bukarest.
- Dowling, M. and J. Linnerooth (1984), The Listing and Classifying of Hazardous Wastes, WP-84-26, IIASA, Laxenburg, Austria.
- Frey, F. and T. Naff (1984) Water: An Emerging Issue in the Middle East? *The Annals of the American Academy*, 65-81.
- Gorove, S. (1964), *Law and Politics of the Danube*, Martinus Nijhoff.
- Jarke, M. (1986), *Knowledge Sharing and Negotiation Support in Multiperson Decision Support Systems*, Decision Support Systems, Vol. 2, pp. 93-102.
- Koehane, R. and Nye, J. (1977), *Power and Interdependence*, Little, Brown, and Co., Boston, Massachusetts.
- Kovacs, G. (1986), Decision Support Systems for Managing Large International Rivers (LIR), Paper presented at the Workshop on Management of International River Basin Conflicts, IIASA, Laxenburg, Austria, Sept. 22-25, 1986.
- Lax, D. and J. Sebenius (1985), The Power of Alternatives or the Limits to Negotiation, *Negotiations Journal*, Apr.
- Le Marquand, D. (1986), International Development of the Senegal River, Paper presented at the Workshop on Management of International River Basin Conflicts, Sept. 22-25, 1986, IIASA, Laxenburg, Austria.

- Le Marquand, D. (1978), *Politics of International River Basin Cooperation and Management*, *Water in a Developing World*, (A. Utton and L. Teclaff, ed.) Westview Press, Colorado.
- Liepolt, R. (1967), *Limnologie des Donau*, Schweizerbartische Verl., Stuttgart.
- Lindblom, C. (1959), The Science of Muddling Through, *Public Administration Review* 19: 79-88.
- Linnerooth, J. (1985), *The Transportation of Dangerous Substances*, Unpublished Draft Report, International Institute for Applied Systems Analysis, Laxenburg, Austria.
- Linnerooth, J. (1984), The Political Processing of Uncertainty, *Acta Psychologica* 56, 219-231.
- Lowi, T. (1964), American Business, Public Policy, Case Studies and Political Theory, *World Politics*, 16: 677-715.
- Loucks, D., J. Kindler, and K. Fedra (1985), Interactive Water Resources Modeling and Model Use: An Overview, *Water Resources Research* (21) 95-102.
- Loucks, D.P., J.R. Stedinger and O. Shamir, Modeling Water Resources Systems: Issue and Experiences, *Civil Engineering Systems*, (2) 223-231.
- Loucks, D. and K. Salewicz (1986), Interactive Modeling and Conflict Negotiation in Water Resources Planning, Paper presented at the Management of International River Basin Conflicts Workshop, IIASA Laxenburg, Austria, September 22-25, 1986.
- Majone, G. (1986), International Institutions and the Environment, in *Sustainable Development of the Biosphere*, (W. Clark and R. Munn, ed.) Cambridge University Press, 351-358.
- Mehta, J.S. (1986), The Indus Water Treaty, paper presented at a Workshop on Management of International River Conflicts, IIASA, Laxenburg, Austria.
- Pichler, F. (1973) *Die Donau Kommission und die Donaustaaten: Kooperation und Integration*, Wilhelm Baumüller, Wien.
- Raiffa, H. (1985), Mock Pseudo-Negotiations with Surrogate Disputants, *Negotiations Journal*, Apr.

- Rhein, Maine, Donau Aktiengesellschaft (1975), Baubericht 1974, 8000 München, 40 Leopoldstr. 28, Apr.
- Schmidt, E. (1986), Member of the Austrian-Czechoslovakian Border Commission, Personal Interview.
- Schmitter, P. (1970), A Revised Theory of Regional Integration, *International Organization*, Nr. 4.
- Sebenius, J. K. (1981), The Computer as Mediator: Law of the Sea and Beyond, *Journal of Policy Analysis and Management*, Vol. 1 No. 1.
- Teclaff, L. (1978), Harmonizing Water Use and Development with Environmental Protection, *Water in a Developing World* (A. Utton and L. Teclaff, ed.) Westview Press.
- Utton, A. (1975), *International Water Quality Law*, International Environmental Law, (Teclaff, L. and A. Utton, ed.) Praeger.
- von Moltke, K. (1987) Scientists, Environmentalists, Local and Regional Officials: Non-traditional Participants in International Environmental Negotiations, Working Paper prepared for the U.S. Environment and Natural Resources Task Group, Processes of International Negotiation Program (PIN), American Academy of Arts and Sciences, Cambridge, Mass.
- Weber, E. (1986), Personal Interview, Apr.
- White, G. (1978), World Trends and Needs, *Water in a Developing World*, (A. Utton and L. Teclaff, ed.) Westview Press.
- Wood, E. (1975), Application of Conflict Resolution Techniques to the Problems of International River Basin Management. WP-75:48, International Institute for Applied Systems Analysis, Laxenburg, Austria.
- World Health Organization (1976), Pilot zones for Water Quality Management in Hungary, Project Report, HUN/71/505, Budapest.