The Political Context of Conflict and Cooperation Over International River Basins

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Introduction

For millenia, along with land and air, water has been regarded as the most basic of natural resources. As commonly observed, it is essential for life itself, as well as for agriculture, industry, energy, fishing and wildlife, forests, recreation, cleanliness, and many other aspects of civilization as we know it. It is a sine qua non of human existence.

Four Basic Features of Water Resources. Along with their extraordinary importance, three additional, somewhat less salient features of the world's water resources also have special political significance. These are scarcity, maldistribution and sharing.

More than two thirds of the surface of the earth--"the blue planet--is covered with water. One might think, therefore, that, after air, it is the most abundant of resources. On the contrary, however, in many parts of the world, especially the Middle East and the African Sahel, it is among the most scarce. This is basically because 97% of our water resources lie in the oceans and are strongly saline, 2% lie frozen in glaciers and ice fields, and only 1% is readily available fresh water.

In addition to overall scarcity, the fresh waters of the earth are significantly maldistributed. Ideally, one would like the water to be where the people are and, within that framework, to be equitably dispersed around the globe. Unhappily, however, the mapping of water resources onto the distribution of population is often extremely poor and there are invidious variations in the water endowments of nations.

As noted, the Middle East in general is a region of relatively acute water shortages. According to many analysts, about 500 cubic meters of water per year (cm/yr), or somewhat more than 100 liters per day, are needed by each person for an adequate existence, though the United Nations and others sometimes use 1,000cm/yr as more acceptable for modern life. In 1990, the per capita availability of water from existing natural sources in Israel was 470cm/yr, in Jordan 260, in the Yemens 240, in the U.A.E. 190, in Saudi Arabia 160 and in Kuwait less than 10. In the United States, by way of comparison, the average annual use (rather than availability) was 2,162cm per capita (Gleick 1991, 21-22).

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Despite the overall shortage of water, the Middle East reveals the same kinds of distributional variations prevalent in the world as a whole. Against the very low availability and use figures above we can juxtapose the following: the per capita availability of water in Iran is 2,080cm/yr and in Turkey, if we divide annual precipitation by population we find about 10,000cm/yr, though all of that is by no means available and roughly a third runs off to seas or other countries. Iraq, moreover, is said actually to use 4,575cm/yr per capita, nearly four times that used by Egypt and twice that used by the United States--indeed, one of the highest water use rates in the world (Gleick 1991, 22, based on World Resources Institute 1990).

Similar variations in the distribution of water occur within countries in the region. Annual precipitation in Turkey, for example, varies by an order of magnitude from about 220mm in some areas to 2,240mm in others, or from arid to wet. Water is most plentiful in coastal and mountainous areas, but much of the population and arable land lie elsewhere. Many areas of the Anatolian plateau get only about 400mm/yr, just enough for dry farming under existing technology.

One prime consequence of having ample overall resources but serious internal maldistribution is that water management, which is very much a political activity, as we shall see, becomes especially important. Moreover, sharp annual and seasonal variability in precipitation add to its significance.

Along with scarcity and maldistribution, the third major aspect of water as a resource that is politically significant is that many of these water resources are shared among nations. More than two hundred rivers in the world are shared by two or more nations. One hundred forty eight are shared by two nations, thirty one by three, and sixty two by four or more (Rogers 1991, 1). The basins of these rivers make up about 50% of the total land area of the earth, and some fifty countries (of about 170 nations in all) have more than three fourths of their national territory within such basins. In 1973, more than one third of the world's population resided in international river basins (United Nations 1978).

Thus, if we consider the combination of these four major features of water as a resource (importance, scarcity, maldistribution and sharing), one outstanding implication emerges--the great need for cooperation among national riparians, indeed even among groups within nation states, and the correspondingly great likelihood of internecine conflict. If water were not vital, actors would be less concerned; if it were vital but plentiful, they would be indifferent to others' usages; if it were vital and scarce but equitably distributed, they would feel that all parties were fairly in the same situation; and if it were not shared, there would be far fewer opportunities for actions that affect others and produce conflict. Moreover, it seems likely that the potential for cooperation or conflict goes up independently with increases in any of these four factors and perhaps according to some yet unknown multiplier for their various combinations.

Political Boundaries and Water Systems. Just as the mapping of water resources onto population is extremely poor, so the mapping of national political boundaries onto natural water basins is often unfortunate. An important distinction is sometimes drawn between international and transnational river systems, the former referring to rivers that form

the boundary between two or more nations, such as the Shatt al-Arab or the Rio Grande, and the latter to rivers that flow unidirectionally across international boundaries, creating upstream and downstream riparians, such as the Euphrates (Kolars 1991, 9; Tekeli 1990, 213). Of course, some rivers can be both international and transnational, such as the Tigris, which very briefly forms the boundary between Turkey and Syria before plunging on into Iraq. My predominant concern in this analysis will be with transnational rivers, particularly, as examples, the Euphrates and Tigris.

One expression of the problems arising from the mismatch between national political boundaries and natural river basins is that, in the language of economics, it prevents "internalization of externalities" (Rogers 1991, 7). An externality exists when the actions of one economic unit directly impact another. One response to such situations is to incorporate both units into a larger unit (internalization), such as a Joint River Commission or similar international authority. Before World War I, for instance, the Euphrates' externalities were internalized under the Ottoman Empire. However, the nations of the world are jealous guardians of their perceived "sovereignty" and existing boundaries. The nation as geographically defined is usually highly symbolic; territorial additions might be acceptable, but territorial losses or losses of relatively autonomous power within established national boundaries is very hard to accept, especially since the politicians asked to do so face strong demands from domestic political networks and are prone to apply a power calculus to such suggestions in addition to any economic or ecological considerations.

A parenthetic comment about analytic bias is appropriate here. It is often assumed, largely on grounds of economic and ecological efficiency, that the natural basin boundaries are somehow superior to the "artificial" political ones. However, such analyses almost always fail to examine the power political costs and benefits of different boundaries as well as the economic/ecological costs. In some cases, it may be worth paying economic and ecological costs (i.e., accepting those inefficiencies) if the political costs thus become even less severe. Political leaders who, often intuitively, follow just such a course, need not be derided as "irrational," "opportunistic," "power hungry" or even necessarily dominated by short-run self-interest. Power costs, benefits and efficiencies, despite their difficulty, must be included in evaluations as consistently as, say, effects on GNP. Indeed, it is important to observe that the GNP concept ignores both resource depletion and power political costs and benefits. This is not a necessary defect of GNP, but merely points to the need in many policy analyses to use other indices as well to evaluate all important dimensions of the situation.

__Population Growth and Economic Development.__ At the most basic level, two related world trends greatly exacerbate the water situation just described. These are __population growth__ and __economic development__, both of which strongly increase water demand.

Many analysts see rampant population growth as "...the causal variable changing most rapidly and ominously in the environmental-social system" (Homer-Dixon 1991, 34). Although some writers argue a strongly optimistic "cornucopian" position that human ingenuity will always find ways to counter resource deficiencies that might limit development, serious difficulties confront such a perspective (Gurr 1985). Among

these are the assertions 1) that such ingenuity cannot be turned on and off like tap water (in some places!) and may not be realized in time; 2) that even if remedial technologies are developed (e.g., ways to save the rain forests), socio-political obstacles may impede their application; and 3) that the magnitude of the challenges, if not the rate, has reached an alarming new level, perhaps crossing the threshhold of our human ability to cope at any given time.

Population growth well illustrates the last contention. World population is increasing at a compound rate of 1.7% per year, producing a doubling time of about four decades. Global population increased from one to two billion over 130 years; it will climb from five to six billion in but a decade. Doubling from one to two billion obviously added only a billion more people; doubling from five billion to ten adds five billion more people. The rates are the same, but the absolute numbers of persons added are different by fivefold, and soon by much more. In the year 1900, there were nine hectares of land for every person, six by the end of World War II, three by 1986, and it is expected that there will be only two by the year 2000 (Falkenmark 1986, 7). The same types of calculations apply to water. The pressures on the world's water resources from population growth constitute one of the most disturbing factors leading toward conflict, especially since population growth seems to be so difficult to control, both culturally and politically.

It should also be heeded that about ninety per cent of the population increase will be in the developing world. Indeed, by the end of the century, around 80% of the world's population will live in the Third World and only 20% in the "developed" countries (Mathews 1989, 63). Some of the most rapid population growth also is occurring in nations that have serious water problems, such as Jordan. One might therefore expect increasing political pressure in the First World to intervene in the Third World for population control, augmented by outcries over deforestation, desertification and other perceived environmental degradations disproportionately occurring there. Resistance and counter-cries from the developing world pointing to fluorocarbons and ozone depletion, hydrocarbons and the greenhouse effect, unfair use of world resources, etc. might be the response, leading to serious hostility not only among nations, but more generally of the First World against the Third.

The other villain in the picture is, oddly enough, economic development, or, at least, certain forms of economic development (Gurr 1985). Economic growth for higher standards of living thus far seems associated with often extravagant exploitation of natural resources, including water. The water history of the city of Los Angeles in the United States is an instructive example, a community reaching ever further into its surround to satisfy an apparently limitless thirst. Witness also the environmental and human damage done in eastern Europe in monomaniacal pursuit of industrial development. The alternative of environmentally sensitive economic development is still mainly an experiment or an ideal, seen as too costly in the short-run or if applied on a large scale.

Economic development is often dependent upon agriculture, especially in its early stages. Agriculture, however, is the dominant consumer of water in the world. As much as 75% of the water used by humans is used for agriculture, and some estimate the overall rate of loss of this

water (in the sense that the designated water never reaches the crops) to run as high as 70% (Falkenmark 1986, 87). Greater international specialization in agriculture would seemingly be much more efficient, letting those nations with natural advantages in agriculture and water produce most of the world's food. Political factors, ~~alas~~, intrude ~~again~~. Nations tend to insist on minimal "food security," which in turn implies water security, which at least in the short run undermines incentives toward efficiency and cooperation. Moreover, without expected economic development or growth, political instability is likely. An expanding economic pie makes governing and retention of power much easier. Until the situation gets dire, political leaders are unlikely to sacrifice power for water conservation, and when it does get dire, they may be more likely to fight or bicker than to cooperate.

In this last respect, it may prove fruitful to contemplate international water situations in terms of catastrophe theory (Zeeman 1976; Holt and Job 1978), specifically cuspoid butterfly theory. This form of catastrophe theory portrays monotonic but non-linear situations in which limited movements in any available direction produce highly magnified and extreme results. A good example is "fight or flight", produced by jointly held wrath and fear. International tension over such a basic resource as water also combines these two elements. As the situation becomes more frustrating and threatening, the nation involved is driven to the cusp of the modeled curve, so that the most likely responses are extremely different from one another. The tension and threat can apparently be resolved either by sharply escalating the conflict or by accepting the necessity of some form of cooperation. Dire conditions may promote cooperation--may even be a prerequisite for it, but those same conditions also make severe conflict more likely. The increased tension from felt resource scarcity can perhaps be regarded as beneficial if it provides the incentive for otherwise unlikely cooperation; on the other hand, it is clearly calamitous if it leads to destructive conflict. Maneuvering to secure the former and avoid the latter may require inordinate political skill.

In sum, then, we confront a different kind of "power shortage" in the world--an international political power shortage. Most nations seemingly do not have the power to control the rampant population growth that threatens world water resources. Ironically, economic development is the one type of change that in time does seem to curtail population growth, but it itself, in most forms, aggravates the water problem. Yet without economic development, or at least its apparent prospect, political instability ensues. Thus, most nations presently do not have the power to control the two greatest pressures on their own and the world's water resources. The tensions increasingly engendered by this situation may drive nations onto the cusp depicted by catastrophe theory, which makes both destructive conflict and constructive cooperation more probable. We therefore confront the problems of determining which outcome is more likely, why, and what might be done to alter their probabilities.

The Need for Theory. From all that has been said, even at an introductory level, it seems clear that we urgently need a predictive theory of cooperation and conflict over transnational rivers (Priscoli 1990, 239). As the social psychologist Kurt Lewin once wisely remarked, "the most practical thing in the world is a good theory." Unhappily, general conflict theories are not very well developed and, at best,

furnish too coarse-grained a perspective to illuminate these special water issues (see e.g., Dougherty and Pfaltzgraff 1971, 138; Wallensteen 1986, 151). The established hydraulic literature is largely descriptive and "surprisingly thin" (Homer-Dixon 1991, 3). Other candidates such as game theory, decision analysis, Pareto admissibility, etc., are much more relevant to conflict resolution than to understanding conflict formation, conflict processes, and so on, as we shall see. However, even if it proves too difficult at present to develop a full-fledged predictive theory of international river conflicts, it would be extremely helpful to work out at least a framework for their analysis that would identify the main variables and suggest some of their significant interrelationships.

General Political Factors

Conflict and Cooperation. If such analytic progress is to be made, it is important to be quite clear about the phenomena of prime concern. The very conceptions of conflict and cooperation are ambiguous and not very convincingly handled in the available literature. Coser (1956, 3), for example, in a classic formulation defined conflict as a "...struggle over values and claims to scarce status, power and resources in which the aims of the opponents are to neutralize, injure or eliminate their rivals." Dahrendorf (1959, 135), in another influential conception refers to "...contests, competitions, disputes, and tensions as well as...manifest clashes between social forces." More recently, rejecting these notions, Blalock (1989, 7) regards conflict as "...the intentional mutual exchange of negative sanctions, or punitive behaviors, by two or more parties..."

I believe that a basic conception of conflict should not restrict either the values over which conflict can occur or the types of tactics through which the conflict is carried out. In general, conflict can occur over any kind of value (or resultant goals) and be carried out by any kind of influential behavior (power tactic). Distinctions among the goals and tactics involved in conflict are surely significant, but they can be elucidated through subordinate conceptualization rather than by limiting the general notion of conflict itself.

To understand conflict it is necessary to understand first the idea of an issue. An issue exists whenever an actor perceives that some of its goals are being blocked (frustrated, denied) by another actor. The blockage may be intentional or unintentional. If the latter, there is a greater chance that the issue may be resolved merely by alerting the unintending blocker to that fact. If the blockage is perceived as intentional, the frustration of the original actor is likely to be increased and aggressive action is more probable. Clearly, however, a given situation (state of affairs) may be an issue for one actor and not for another. Issues lie in the eyes of their beholders.

If the blockage is intentional and perceived as such by both parties, the issue may be said to be joined. If each party is seen as intentionally blocking some related goals of the other, the issues are mutual. Most immediately important, if one actor attempts to exert power over another to overcome that actor's perceived blockage of the first actor's goal and faces significant intentional resistance, a conflict exists. Obviously, some of the terms in this set of concepts

need further explication, which space precludes here. But these are the key notions as they will be used in the subsequent analysis.

Cooperation, being rarer than conflict, not usually pernicious and receiving less analytic attention, is even less well understood as a concept. In ordinary language it usually means "working together for common benefits," and that may suffice for the present discussion. It implies coordination of behavior among actors to realize at least some common goals. At this same level we understand that conflict implies mutual frustration of goals as opposed to the mutual enhancement of goals in cooperation. Conflict thus implies some felt divergence or incompatibility of goals and cooperation implies some felt agreement or compatibility of goals.

Both conflict and cooperation refer to an interaction among actors, individual or group, i.e., to certain systems of interactor influence or power. Conflict is by no means always or inherently negative, either for the individual actor or the social system, as Coser (1956) saw so well. Nor is cooperation always positive, as, for example, in situations of collusion. Instances of each have to be specifically examined to make such evaluative judgments convincingly.

As a dynamic interaction, conflict has phases and aspects that can be fruitfully distinguished. At the crudest level, we focus on conflict formation (the etiology of conflicts, how conflicts begin), conflict processes (how conflicts are waged), and conflict resolution (how conflicts are, or are not, terminated). Some approaches to modeling conflict, ~~as we shall see~~, are much more appropriate for one phase than for another. Game theory, negotiating models, and several other such perspectives seem more useful for dealing with conflict resolution than with conflict formation or processes.

Not all or even most conflicts lead to violence. Nor are all conflicts "resolved" in any plausible meaning of that term. Many fester for decades or longer, perhaps costing as much in their own way as the more striking damage of violence. Some are even settled according to international law, viewed by many as "a consummation devoutly to be wished."

International Law. Conflicts over river basins within countries often are finally resolved by the domestic legal system. One might expect the same, mutatis mutandis, for international conflicts--the resort to international law. At present, however, this is more of an ideal than a realistic alternative. "The international legal system is generally characterized by a highly developed body of substantive legal doctrine coupled with a primitive set of legal institutions" (Dellapenna 1984, 157). As regards international river basins, even the doctrine is uncertain.

Four or five primary legal principles, often competitive, are available. These are: 1) absolute sovereignty (a nation can do what it wants with the water in its territory); 2) absolute integrity of the river (no riparian can change the natural flow of the river); 3) community of property in the river (reasonable share or equitable use by all riparians, not causing unreasonable harm to any other riparian); 4) optimal development of the river basin (development of the basin without regard to national boundaries); and 5) restricted sovereignty (riparian share tied to such criteria as historic use, arable land, population, etc.). The first two of these principles are contested by downstream and upstream riparians, respectively, while the other three involve

crucial uncertainties over judgmental notions such as "reasonable," "equitable," "optimal," and the like, over choice of allocational criteria, or imply basin-wide institutions that may not exist.

Recognizing the criticality of international river basins, after eleven years of consideration, the United Nations delegated the codification of international water law to the International Law Commission. Following several additional decades of deliberation, that agency released its recommendations at the end of 1991, but the prospects for consensus on a legal doctrine for international rivers still seem slim. The International Law Association, which promulgated the nonbinding Helsinki Rules of 1966, the Institute of International Law, and the U.N. Environment Program all have commented on water doctrine without much impact. Moreover, even if such doctrine did emerge, the lack of effective institutions for adjudication and enforcement would still blunt its effect. The International Court of Justice, for example, can only hear cases if the parties consent to its jurisdiction, which is unlikely if they feel strongly about the conflict, have grounds to fear an adverse decision, and think they can do better by using their own power.

Although several secondary sources exist, the basic source of international law is international agreements. More than 280 treaties dealing with water issues have been signed by nations, attesting to both the prevalence of water conflict and the possiblity of its resolution. Two-thirds of these treaties have been in Europe and North America where the modern development of water resources has proceeded furthest. Large scale, contemporary water projects are newer in the developing world (Vlachos 1990; Rogers 1991, 1).

Without such an international treaty or agreement, the real force of international law now lies mainly in its effect on public opinion. A relatively blatant violation of the more widely accepted international legal principles (e.g., that precluding out of basin water transfers without riparian agreement) may have undesirable effects on the image and perceived legitimacy of the offending nation. Thus, the International Water Tribunal, a private judicial entity supported by some 85 European environmental organizations, has produced verdicts in 19 pollution cases and the associated publicity apparently has led to corrective action in many instances (Falkenmark 1986). Members of the United Nations are also bound by its charter to eschew wars of aggression, and it is possible that the Security Council will play a more active role in discouraging extreme conflict now that the Cold War seems ended. Nonethelelss, a major role for international law in international river basin conflicts seems elusive.

Typologies and Profiles. Some analysts have attempted to fathom the nature of conflicts by organizing them into types, each of which supposedly has distinctive characteristics. Hence, if one knows which type of conflict ("issue area") one is dealing with, one can predict other important features of that conflict. Various writers have thus distinguished "high politics" (national security, foreign policy) from "low politics" (economic and welfare matters), crisis politics from routine politics, or military, political, economic and socio-cultural conflicts.

Several researchers on international water resource conflicts have suggested typologies they find fruitful. For example, Homer-Dixon (1991) selects three theoretical perspectives on "acute conflict" from

the general conflict literature: frustration-aggression theory, group-identity theory, and "structural" theory. On this basis, he discerns three main types of conflict: simple-scarcity conflicts, group-identity conflicts and relative deprivation (structural) conflicts. He uses the Euphrates as an example of a simple-scarcity conflict (p.39), though admitting that it is not a "pure" instance.

In any event, the problem with the approach is that general conflict theory is, simultaneously, not really general (i.e., it omits important aspects of conflict phenomena) and too general (i.e., it does not bring out the key features of water resource conflict as distinct from any other type of conflict). Frustration-aggression, group-identity and relative deprivation frequently are all present in each of the three types of conflict suggested. The typology thus becomes extremely difficult to apply to any specific case. Moreover, though awareness of the three perspectives--indeed, of the individual, group, and macrosocial levels of analysis--is indisputably essential, many other important features of conflict are omitted while few specific insights into water conflicts emerge, as the author candidly acknowledges (p.43). Other writers propose typologies of cognitive, stakeholder, and ideological conflicts (Vlachos 1990), or informational, interest, value, and relational conflicts (Priscoli 1990), and so on, that are even less theoretically impressive.

Undoubtedly the most broadly influential of the general conflict typologies is Lowi's distinction of distributive, regulatory and redistributive issues (policy-areas), to which he later added constituent issues (Lowi 1964). It has been said that "no single theoretical construct has been more important to the development of public policy studies than Lowi's categorization scheme..." (Potter and King 1976, 2).

Distributive issues are disaggregated, small scale, patronage type matters involving individual firms, unions, and other relatively modest units; regulatory issues are less disaggregated, follow less ad hoc, more general rules, and involve basic sectors of the society; redistributive issues are at the broadest level of social classes and movements and the highest level of political intensity, since it is manifest that they take from one social stratum and give to another.

For present purposes, the key feature of the typology is that each of these three issue-areas is said to produce its own politics. Lowi asserts that "each arena tends to develop its own characteristic political structure, political process, elites, and group relations." Thus, if one accurately identifies the type of conflict, issue or policy, one can predict the actors, goals, perceptions, recruitment, structures, and other key political features involved. If true, this would give us a mighty "leg up" in understanding water conflicts.

Unfortunately, however, this intriguing idea tends to break down in specific analyses. International river basins are difficult to classify under this scheme. They are multi-faceted, largely because water has so many uses and applications. Moreover, the typology, broad as it is, comprehends only some of the crucial features of most issues, including water. Such qualities as being unique or recurrent, symbolic or pragmatic, secret or open, expensive or cheap, overtly power-related or not, intrinsic or instrumental, etc., are not very explicitly considered. More generally, it seems unlikely that complex conflicts can be comprehensively handled by any single typology with a single or

very limited logical base. This is not to deny the utility of the dimensions used, but to stress the utility of many dimensions not used in the typological format.

A superior approach to dealing with the manifold dimensions of conflicts over water and many other resources is likely to be the use of multifaceted conflict or issue profiles--actually multiple typologies. An example of such a profile for an Israeli view of the conflict over the Jordan basin is given in Table 1 (from Frey and Naff 1985, 72). While more realistic than unidimensional typologies, the difficulty at present with the profile approach is that the predictive hypotheses associated with various common profile patterns--analogous to the predictions about actors, goals, structures, etc., of some typologies--have yet to be developed. Application of the profile approach to diverse water and other conflicts could help establish common profile patterns and their implications.

Models of Conflict Behavior. If typologies have not led to much predictive theory about the politics of international water basins, perhaps a more fully developed modeling approach could do so. A model is basically a representation of one phenomenon by another, though sometimes the word slides into what would more aptly be called a theory or "theorita" (mini-theory). Analytic models are useful if ~~the second phenomenon, the model~~ they accurately reproduce the relevant aspects of the modeled phenomenon and is more accessible, more understandable, more manipulable, less expensive, etc. A much more complete and profound treatment of water conflict modeling than can be provided here is necessary; I shall simply sketch some of the most salient features of common models in order to discuss their gross contribution to predictive theories of conflict and cooperation.

Appropriate models might be found to portray the origins, processes, and outcomes of conflict. For example, I have already briefly discussed mathematical catastrophe theory as one possibly useful model for water resource crisis outcomes. Obviously, it is a very limited model, but it does bring out quite clearly the important point that either acute conflict or cooperation may be especially likely in situations of very scarce water resources. According to the theory of the cusp, such situations will tend to produce either conflict or cooperation, but they are unlikely to revert to "business as usual." However, the model is not very informative about which to expect, the processes involved, when it applies, etc. (For a strong critique, see Zahler and Sussmann 1977).

In general, it is convenient to categorize available models of conflict and cooperation according to which phase of the conflict/cooperation phenomenon they portray. Thus, one can basically distinguish outcome models from process models. Outcome models tend to apply to conflict resolution and sometimes to conflict formation, with the outcome in the first case being conflict termination, continuation or escalation and in the second case the outbreak of conflict (perhaps acute or violent) or not. Process models tend to apply to the waging of conflict or conduct of cooperation, although they can apply to the process of conflict formation or termination as well. Usually, the difference between the two is a matter of degree.

One outcome modeling approach that has sometimes been applied to water crises is game theory. The riparians are assumed to be playing a noncooperative game in which they know the strategies and payoffs of all other parties, and try to determine a rational, cost-benefit strategy

1-2 sentences re game theory

for themselves, assuming the others are committed to their respective choices. Under such conditions, game theory suggests likely outcomes. One of the chief interests of the game theorist is whether there exists a stable equilibrium for the particular game examined. That equilibrium is commonly defined as a system of players' strategies, under the above assumptions, in which no player can change tactics and improve his payoff; given the strategies of the others, each has no better move than the one he has chosen.

More complex and realistic assumptions can be made, such as permitting side payments, iterated games, and so on, but it cannot be said that game theory has as yet made much contribution to the analysis of basic resource conflicts in any predictive sense. One major problem lies in the rather unrealistic cognitive and motivational assumptions necessary to the logic of game theory. In actual conflicts, actors often do not know or misperceive their opponents' goals and strategies. In fact, even their own goals and strategies are the result of internal power processes, as I shall stress later, and may not be totally coherent or transitive. A well worn example is the U.S. government's simultaneously subsidizing tobacco farmers and issuing public announcements that smoking is hazardous to your health (policies which, incidentally, may be completely logical and coherent from a political power perspective).

Adjustments in game theory probably can be made to deal with some of these problems, such as the promising work on "nested games" or more explicit inclusion of power motivations in determining payoffs and strategies; but the very logic of game theory, requiring rational unitary actors rather than modeling systems interacting with other systems, implies some serious limits. On the other hand, like catastrophe theory and other such models, game theory has alerted us to some important features of conflict situations that were not well recognized, such as the likelihood of stable, suboptimal solutions to certain kinds of situations (e.g., Prisoner's Dilemma).

Transition

Rational modeling of transnational river situations in terms of Paretian Environmental Analysis has also been suggested (Dorfman et al. 1972; Rogers 1991). These models use the fundamental economic notion of Pareto optimality or admissibility to establish criteria which solutions to water conflicts should meet--essentially, criteria for equity (and, thus, perhaps for cooperation). It assumes that each riparian can identify its net benefits under any proposed basin plan, and that each nation is trying to maximize those net benefits. Any plan that, compared to some other plan, does not reduce any nation's net benefits and increases at least some nations' net benefits is superior. A plan is Pareto admissible if there is no other plan that is, in this sense, superior to it.

Pareto admissibility and later variants or improvements, such as Baumol's (1986) "superfairness," seem to be useful but limited models for basin-wide planning and may have some prior utility to nations in their negotiations or in suggesting possible resolutions. They are not, however, models dealing with the origination or processes of conflict, and they relate to conflict termination primarily by offering an image of equitable resolution, if one accepts their assumptions.

Another set of models that has been applied to transnational river basin conflicts relates to the negotiation process and conflict management. These models, such as ADR (Alternative Dispute Resolution)

and PIN (Processes of International Negotiation), model constructive approaches to negotiation, serving as a template for negotiating success rather than as a predictive model of actual conflict processes or outcomes (Priscoli 1990; Potapchuk et al. 1990). They concentrate on identifying the interests (values and goals) of each party to the conflict and enjoin a collaborative effort, a mutual search, to find a solution that maximally satisfies each actor's interests. They present wise counsel and incorporate a partly implicit, partly explicit theory of negotiating processes; but, like the other models thus far discussed, they deal with only a limited part of the conflict/cooperation phenomenon and are more prescriptive than predictive.

A related approach to resolving conflicts over transnational water resources by assisting the systematic evaluation of alternatives is the Multi-Attribute Tradeoff System (MATS) of the U.S. Department of the Interior and similar computer packages (Smith and Al-Rawahy 1990). Water proposals are evaluated in terms of key "factors" such as 1) yield (the net quantity of water added), 2) feasibility (the realistic prospects for implementation), 3) dependency (how surely the plan will produce the designated results), and 4) political impact (the plan's socio-political consequences). The last factor is the most significant for our present analysis, but it is not very sharply elaborated beyond the kinds of suggestions previously discussed.

Finally, a few directly political "models" have been put forth for transnational water situations, although these are better labeled as crude, limited theories than models in any strict sense. LeMarquand (1978) asserts that five different foreign policy factors influence a nation's riparian stance: image (concern for its international image), international law (its concern to abide by established legal rules), linkage (connections between water and other issues that may produce concessions), reciprocity (its desire for mutual commitment and obligation), and sovereignty (the stress it places on autonomy compared to other values). He also notes three domestic factors that loom large in water policy: 1) bureaucratic policy processes (internal power relations within the bureaucracy), 2) executive policy processes (the degree of involvement of a President, Prime Minister or other chief executive in water matters), and 3) residual policy processes (pork barrel, coalition politics that may use water as a political weapon). While useful for calling our attention to matters that might otherwise be missed, listings such as these are relatively unsystematic and atheoretic.

Frey (1984), by contrast, strives to present the simplest effective "model" for understanding the origination of violent conflict in transnational river basins. It asserts that three main factors can predict, very roughly, this conflict potential: 1) the <u>importance</u> of water to each actor, 2) the relative <u>power</u>, primarily military, of each actor, and 3) the respective <u>riparian positions</u> of the actors.

Importance is the most elusive of the three factors. It refers to how much the nation wants or needs the water, the policy or the project involved--i.e., it's value priority. The Euphrates and Tigris, for example, were of very little significance to Turkey until quite recently. But, with GAP and the desire to develop the Southeastern Region, their importance has changed drastically. At the same time, the rivers are also extremely important to Syria and/or Iraq, the Euphrates increasingly so to the former. Hence, the rising importance of both

rivers for Turkey and the Euphrates for Syria, together with their continuing importance for Iraq, has changed a situation of relatively low conflict potential to one of much higher potential.

Relative power, as stated, refers primarily to military power and has two main dimensions--defensive power and projectable power. The essential consideration is the ability of the nation to defend its own water resources against the use of force by others or to obtain its water goals by use of force against others. Israel might be considered a prime example in the sense that it changed its position from downstream to upstream by the use of force and often destroyed water installations of other riparians which it found threatening.

Third, riparian position essentially refers to being upstream or downstream vis a vis other nations. The enormous advantage of being upstream is that one is thereby in a favorable power position, able to present downstream riparians with faits accomplis. Analytically, three absolute riparian positions need to be distinguished: upstream, midstream, and downstream. Upstream means being first with significant flow, downstream means being last, and midstream refers to any riparian between the upstream and downstream nations. One might also distinguish various degrees of remove from other riparians in either direction. In conflict, the upstream riparian is advantaged, the downstream riparian disadvantaged, and the midstream riparians have several ways of playing their roles. Coalition formation, also strongly affected by riparian positioning, may alter these power relations. The two most common of such coalitions being that of the midstream and downstream riparians versus the upstream nation and that of the upstream nation and its immediate midstream neighbor(s), bought off by favorable treatment from the upstream state, versus those still further downstream.

According to this rough perspective, we see that Turkey is in a rather strong positon on the Euphrates (see Table 2). She is the upstream riparian and has enough military power to make the use of force against her by Iraq and Syria a dubious venture. In addition to the increased importance of the water for Turkey, the main change that has recently raised the potential for conflict is that, for the first time in history, Turkey has obtained control over the flow of the Euphrates and soon may control much of the flow of the Tigris through the GAP project. These developments, in turn, have markedly increased the insecurity and anxiety of the downstream riparians, Syria and Iraq. Blocked from redressing matters by force, they are likely to employ other forms of conflict behavior unless some mutually satisfactory cooperative resolution can be reached. As yet, leadership rivalries and other factors have obstructed their obvious coalitional affinities.

Table 2 applies this basic predictive model to the Jordan and Nile as well. The most stable situation exists when the upstream nation is also most powerful and has least interest in the water. The least stable is when the downstream nation is most powerful and has most interest in the water. From Table 2 we see that the Jordan, after Israel's forcible change of her riparian position, has become much more stable, and that the Nile has the greatest conflict potential of all, other things equal. However, to pursue the political analysis of transnational river basins such as the Euphrates, Jordan and Nile more effectively requires focused power analysis and a systematic framework for doing so.

TABLE 1

ISSUE PROFILE: A CURRENT, COMMON, INFORMED ISRAELI VIEW OF THE JORDAN WATER ISSUE

Routine	___	___	___	___	✓	___	___	Crisis
Symbolic	✓	___	___	___	___	___	___	Pragmatic
Domestic	___	___	___	✓	___	___	___	Foreign
Unique	___	___	___	___	✓	___	___	Recurrent
Contagious	___	✓	___	___	___	___	___	Isolated
Aggregate	___	✓	___	___	___	___	___	Disaggregate
Secret	___	___	___	___	✓	___	___	Open
Short-run	___	___	___	___	✓	___	___	Long-run
Intense	___	___	✓	___	___	___	___	Relaxed
Public	___	___	✓	___	___	___	___	Private
Technical	___	✓	___	___	___	___	___	Nontechnical
Power	___	✓	___	___	___	___	___	Nonpower
Simple	___	___	___	___	✓	___	___	Complex
Prestige	___	___	✓	___	___	___	___	Nonprestige
Legitimate	___	___	✓	___	___	___	___	Illegitimate
Costly	___	✓	___	___	___	___	___	Cheap
Tangible	___	___	✓	___	___	___	___	Intangible
Many-actor	___	___	✓	___	___	___	___	Few-actor
Narrow	___	___	___	___	✓	___	___	Broad
Zero-sum	___	___	✓	___	___	___	___	Non-zero-sum
Survival	___	✓	___	___	___	___	___	Nonsurvival
Intrinsic	___	✓	___	___	___	___	___	Instrumental
Old	___	___	___	✓	___	___	___	New
Symmetric	___	___	___	___	✓	___	___	Nonsymmetric
Salient	___	___	✓	___	___	___	___	Background

Table 2

Riparian Power Estimates for Three M.E. River Basins

	Riparian Power Factors			
Nation	Importance	Power	Riparian Position	Total
Euphrates:				
Turkey	4	5	5	14
Syria	4	3	3	10
Iraq	4	4	1	9
Jordan:				
Israel	5	5	4	14
Jordan	5	2	3	10
Syria	2	3	2	7
Lebanon	2	1	2	5
Nile:				
Egypt	5	5	1	11
Sudan	4	2	4	10
Ethiopia	2	1	4	7

Note: Revised from Frey (1984, 194). This table is intended merely to be illustrative. The weighted entries are impressionistic and on a scale ranging from 1 to 5. The estimate of relative military power refers to its use for specific basinal water goals and, for Iraq, to the period before the Gulf War.

Power Analysis of Transnational Water Basins

Although the term is ambiguous, by "power" I refer to a relationship among actors (i.e., individuals or unitary groups) such that the behavior of one or more actors at least partly causes the behavior of one or more other actors. Conflict, by definition, implies power, at least in the sense that one actor attempts to cause another actor to change that behavior which is seen as blocking the goals of the first actor, and the second actor intentionally resists.

The analysis of power has numerous facets, including the actors involved, their motivations and cognitions, the many significant features of their behaviors, the timing of their actions, the foci of interaction (issues, activities), the settings in which they occur, the structures of interaction, and the sources of change or inertia in these power relations (power dynamics). It is obviously impossible to consider here each of these facets of power relations as manifested in transnational river basin situations. Consequently, I shall select a few topics to illustrate the kinds of insights that can emerge from power analysis.

Actors. Analyzing any power relation requires designation of the actors and the behaviors involved, behavior being broadly defined to include acts and actions (i.e., interpreted behaviors). Some immediate problems arise in dealing with transnational river basins and, though not unique, they are important. One has already been mentioned briefly--the fact that we are initially dealing with group actors (nation states) rather than with individual actors (persons). These group actors, moreover, are themselves very large and complex systems. We are justified in treating them as unitary actors so long as they behave in a unitary fashion, i.e., ~~so long as we can accurately predict the behavior of the other members of the group from the behavior of but a few known members of the group, usually its leaders; in other words~~, so long as the group basically behaves as a single entity. However, certain other features of political actors are different when one is dealing with very large and complex group actors.

One such difference involves notions of the actor's goals, costs, benefits, etc., and their "rationality." As previously discussed, a nation's goals in transnational water relations are usually the result of an internal power process involving many domestic actors. Those internal power processes may produce a set of goals that does not display the coherence, transitivity or "rationality" assumed in many analyses of transparent "national interest." Constituencies of farmers, bureaucratic organizations, political parties, business interest groups, provinces, and others may be successful in certain areas of water policy and unsuccessful in others, producing more a mosaic of policies than a neat, integrated package. Of course, this is but a reformulation of Allison's (1971) thesis of the differences between "rational national actor" politics and "bureaucratic politics." In water analyses, however, the latter is often neglected.

Transnational water politics often produce new actors on the political scene, and possibly new politics to go with them. One very common example is the transformation of domestic politics in the river basin from the traditional national-provincial-local organizational framework to a new set of regionally-focused actors. The GAP project in Turkey, for instance, is regionally oriented. If it is successful, new

regional administrative units will be formed and bear important tasks, the political parties will have to develop regional organizations if they expect to have an influential voice in water policy-making, business will need regional representation, as will farmers' unions, and the like. Hence, the old political strata of national and provincial administration will have to adjust to a potent, new, interstitial regional layer that will certainly alter the others and may eventually eclipse them. It remains to be seen who will be advantaged and disadvantaged by this in power terms, but some certainly will.

At the local level also, new water-related actors will emerge. Water projects spawn a variety of identity-groups that express new values and cross traditional jurisdictional boundaries (Priscoli 1990, 237). Indeed, the need for "water discipline" in large irrigation schemes means that the government often must take the lead in establishing useful new organizations such as farmers' cooperatives which, once established, change the political arena. Local irrigation institutions tend to be channel-based rather than traditionally village-based and put different issues on the political agenda from those customarily encountered (Bottrall 1978, 317).

I have already noted that water conflicts may lead to the formation of new international coalitions, so we see that conflict and cooperation over transnational river basins may recast the sets of actors on the political stage both internationally and domestically. This, in turn, tends to increase short-run uncertainty and may exacerbate conflict or stimulate cooperation.

Motivation. Motivational factors are crucial to actors' behavior in hydraulic conflicts. Like actor designation, the analysis of motivation is complex, and I shall be able to consider merely an example or two.

An interesting aspect of motivation in water conflicts reveals one of the vicious cycles that can be present in such situations. Water is often said to be strongly linked to national security, though security of what (national existence, sovereignty, water rights, existing power patterns, etc.) is frequently unclear. Water conflicts generally occur among neighbors--riparians on the same river. Thus, the parties to the conflict usually have relatively intense and highly ramified relations with one another in other respects in addition to sharing water. These relations affect their interaction over water, and vice versa.

One very common and disturbing pattern is for there to be tension among riparians prior to the emergence of water conflict. This tension leads to heightened concern over "security" in general and for maintaining "food security" in particular. "Food security," in turn, leads to special emphasis on agriculture, which increases the demand for water and "water security." Stress on "water security" leads to more tension with riparian neighbors over water, which leads to increased general concern over "security," stiffer defense of agriculture, and so on, through a self-reinforcing, conflict-bent cycle. The history of the Jordan riparians reflects these tendencies. Hence, transnational river basin conflicts must be considered in light of the other, non-water relations among the riparians and the general "climate" of agreement or disagreement, hostility or good will.

Basic motivational distinctions employed in power analysis include those between intrinsic and instrumental motives, egocentric and exocentric motivation, and the degree and nature of the "bounding patterns" of motives (how limited or unlimited the motive is along

specified dimensions). Water is sometimes an instrumental as well as an intrinsic value. One such instrumental use is water as a political weapon--employing water as a means for reaching other goals, such as power in other areas. Under extremely scarce conditions and extreme water advantages and disadvantages, "...the temptation to use water for political purposes may prove irresistable. Even the perception that access to fresh water could be used as a political tool by another nation may lead to violence" (Gleick 1991, 5, citing the riparian conflict between North and South Korea). It may also lead to subtle influence through the well-known power phenomenon of "anticipated negative reactions." Other actors may be reluctant overtly to oppose the dominant water power for fear of repercussions over essential water resources. The dominant power may also realize and exploit this tacit advantage, which is what leads the weaker, usually downstream riparians to resist so strongly any likely increase in the hydraulic control of the potentially dominant power before it becomes an actuality. Thus Syria was at great pains to prevent Turkey's obtaining international financing for the GAP Project, successfully arguing to the World Bank, Islamic Development Bank and others that funding should not be granted in the absence of an international agreement among the riparians.

An example of fear of the use of water as a political weapon is furnished by the Socialist Party of Turkish Kurdistan. They see the GAP project as an attempt to undermine Kurdish nationalism and influence in the southeast region of Turkey. They regard the Euphrates and Tigris as "our water" and the project as a sinister plan to deprive them of it. Moreover, they think that the hidden motive behind GAP is to increase the regional labor force sevenfold, with the influx primarily from non-Kurdish Turks, so as to solve the so-called Kurdish problem by swamping them and dominating the region. The benefits from GAP, they allege, will go to the western areas of Turkey, to large landowners, foreign interests, and big holding companies. One might regard this view as epitomizing perhaps the ultimate, Machiavellian view of water as a political weapon, although it is difficult to find informed, seemingly objective analyses of the types of problems envisioned. Some of them, more moderately expressed, are not without face plausibility and deserve examination.

On this point, it should be noted that just as water is often used as a political weapon in both hydraulic and other conflicts, so other types of political resources are used as political weapons in water conflicts. An example is the alleged Syrian support of Kurdish unrest in Turkey to gain leverage over Turkey with regard to their outstanding water differences. Severe water conflict thus tends to become generalized into all areas of interaction that can provide useful influence in the water dispute. And, if water is used as a weapon in other conflict areas, the water conflict is even more likely to expand and intensify.

Cognition. In analyzing conflicts, just as one must identify the actors involved and determine what they want from the given situation, so one must determine how they see things, especially each other. The significance of images, perception and misperception in politics is well established (e.g., Jervis 1970, 1976; Frey 1991). Water resources and projects are frequently highly symbolic to policy-makers and publics both within the nation and outside. The Aswan High Dam, the East Ghor Canal, the National Water Carrier, the Tabqa Dam, and the Ataturk Dam are examples--as is often apparent from their very names. The emotional

significance of these installations produces both opportunities and limits politically. Leaders can use it to gain sacrifices and support that would otherwise be lacking, as in the popular contributions to the Ataturk Dam in Turkey and the ability to use deposits from the Public Housing Fund. On the other hand, such symbolic significance may make policy more rigid, retrenchment more awkward, and delay more damaging. Hydro-policy may become a political bellwether, seen as a panacea and overemphasized when things are going well and downgraded or abandoned when things become difficult. Individual politicians also tend to become identified with particular water policies, staking their reputations on one stance or another. When this happens, water policy may often become a handmaiden to a particular political career, subservient to its power dynamic.

A troublesome perceptual feature of water resource politics is that the major ventures require a long time for completion, often decades. Political systems, on the contrary, operate much more in the short-run, as evidenced in terms of office, annual budgets, etc. This makes water planning especially difficult. Certain component tasks of planning, such as the engineering, can be projected over long stretches of time much better than others, such as the socio-political consequences or long-term economic impacts. Very often, this means that the former are played up and the latter played down, and people are surprised when, five, ten or twenty years later the project exhibits many flaws that were not well foreseen. Some analysts comment on the seemingly distorted balance of hydraulic plans that devote volumes to the more technical engineering aspects, a chapter or so to financial features, and at best a few vague pages to the socio-political implications. Critics also flag the tendency of such plans to emphasize the benefits but be much less specific regarding the beneficiaries, though this may be merely shrewd power tactics.

I have already referred several times to the importance of images in transnational water politics. Images are a subtle but frequently crucial factor shaping the behavior of participants in varying degrees. Thus, Turkey is at pains to maintain the image of a responsible regional and world actor, assuring Syria of 500cm/sec Euphrates flow and avowing that it would never use its control over the river as a political weapon. However, some prominent politicians take a much tougher line, and even the more moderate regimes occasionally slip and indulge in threats. Moreover, Turkey's external image for some is that it is reluctant to enter into an international basin agreement that includes a genuine basin authority--that Turkey wants to have control of the rivers in its own hands but reassure others so that they are not anxious about it. Such a goal, however, may be quite unrealistic, since the anxieties are not capable of being allayed in this fashion. Divergent images may also be dangerous; each actor feels that its noble values are transparent and its needs compelling, but views the others with supposedly justifiable suspicion, and so conflict continues.

The impact of images, however, is varied and subtle. Just as the dominant water power must deal with considerable suspicion no matter how earnestly it tries to assure other riparians, so there are advantages to some kinds of apparent weakness or vulnerability. Wallensteen (1986, 150) contends, for instance, that constraints on the use of a resource as a political weapon are, paradoxically, fewer when the target nation does not depend on that resource for survival. Reducing or threatening

to reduce the water resources of Iraq, for example, would thus be more thinkable than doing the same to Jordan, especially if an image of Iraq as a profligate and inefficient user of water were also established. One must, however, consider the nature and importance of their regional and international images to the actors involved; some nations are more impervious than others to their international images.

Structure. To understand how significant its international image is to a nation--how vulnerable it is to influence in that area--one needs to understand that nation's structural position in the world political system. In any given conflict or issue area, one needs to know what other actors have significant influence over the given nation (its power field) and what actors are significantly influenced by the given nation (its power domain).

Turkey, for instance, is concerned with obtaining full membership in the European Community, is a member of NATO and wishes to play a certain role in that organization, has important trade and financial relations with Iraq and Iran and is interested in economic opportunities in North America, the Middle East, perhaps in the Black Sea area, Central Asia, etc. Hence, its international image is a rather important concern. Syria is recasting its role in the Middle East to some extent and is, at least for awhile, also likely to be sensitive in this area. Iraq, though not totally neglecting such considerations, has been much less sensitive to many international image concerns. One might expect, therefore, that the conflict among the Euphrates riparians would include considerable attention to image damage and protection, with Syria and Iraq regarding Turkey as vulnerable in this area and Turkey seeking to protect itself. Syria and Iraq would tend to concentrate most strongly on the water issues alone, while Turkey would seek to exploit the generally more negative images the other two riparians have in the world at large. Detailed analysis of structural relations is necessary to understand how these tactics would play in different regions (e.g., Europe vs. the Middle East) and in different nations.

The structural notions of power domain and power field are also useful in understanding power motivation. The larger an actor's power field, the less its autonomy; the larger its domain, the greater its dominion. A prominent hypothesis is that loss of power is more compelling than gain in power. Specifically, actors are most concerned to avoid loss of autonomy (increase in field), next most to avoid loss of dominion (decrease in domain), next to increase autonomy (reduce field), and next to increase dominion (increase domain) (Frey 1991). If we apply this to water conflicts, it might suggest that nations would be more concerned to avoid loss of water and water control than to gain them--that those facing the prospect of such loss would be more likely to engage in severe conflict than those with the hope of gain. However, the weights to be put on each of these orientations are not yet known.

By the term structure I refer to the patterning or configuration in the power relations among a designated set of actors. Thus, we can discern highly concentrated from highly dispersed patterns, polarized from less lumpy patterns, systems in which the separate patterns of power across issues all strongly resembly one another (high structural isomorphism--high STRISO, for short) from those where they are quite different (low STRISO) or those where the specific actors are in the same relative positions across issue structures (high PRISO) and those where they are not (low PRISO), etc.

Structural factors permeate almost all aspects of transnational water conflicts. A basic proposition that several writers have considered is that scarcity of a major resource leads to increased concentration of power in the system involved, causing, particularly in the Third World, "...the establishment or strengthening of the bureaucratic-authoritarian state" (Gurr 1985, 700). It may also be argued that we here confront another vicious cycle of politics similar to the one discussed previously. In this case, scarcity leads to increased concentration of power, which tends to reduce innovation and initiative, which tends to increase scarcity under rising demand, which increases the concentration of power, etc. An important, corollary research topic would be to investigate the relationship between the concentration of power in states and their tendencies toward conflict or cooperation. It is commonly asserted that democracies are less prone to war, but a more complete analysis of the connections between the internal distribution of power and external conflict behavior is yet to be accomplished, largely because measurement of the distribution of power in political systems has proven difficult (Frey 1985).

Water management also seems likely to have important effects on the structures of power within nation-states. Its power problems change over time, becoming more complicated as general and hydro-development occur. "As water demands increase in size and number, water management proceeds from being supply-oriented [increasing supply] to being resource-oriented [water storage and redistribution] and then to being demand-oriented [controlling demand]" (Falkenmark 1986, 88). The control of demand for water would seem to place different and more onerous political power burdens upon a regime than earlier phases, involving it in processes of invidious redistribution rather than the more optimistic challenges of increasing supply.

The internal processes of water development and management have crucial power aspects. Some analysts have maintained that most hydraulic planning has been quite "paternalistic," and that "...the technology adopted largely reflects the interests of those holding power in society (e.g., politicians, bureaucrats, urban consumers, large landowners)..."; technology appropriate to the majority of the people involved is excluded. Morever, the technology is externally generated but "...institutional change is not occurring to keep up with the technical potential" (Carruthers 1978, 307). Consequently, "...the performance of most irrigation schemes in the developing world has been very disappointing. Planners' targets are rarely met: the overall productivity of water is much lower than might be expected and, especially on large surface-water delivery systems, the pattern of its distribution is often extremely inequitable, with farmers in the head-reaches receiving far more than those at the tail...[A] very significant part of this poor performance (though by no means all of it) can be attributed to deficiencies in 'management'..." (Bottrall 1978, 309). In some respects, then, the internal management of water is a microcosm of the transnational river basin, with similar political characteristics.

Computer Simulation of Transnational River Basin Conflicts. Perhaps it would also be useful to mention the efforts that we are making to develop a computerized simulation of transational river interactions. The basic purpose of this very preliminary simulation is to predict whether a given situation will escalate to severe conflict, will continue at a moderate level of conflict, or will abate or be resolved.

The model is deliberately as simple as possible in the initial stages of its development, though it contains opportunities for greater elaboration later. Its present form is essentially as follows.

The simulation starts with designation of the actors (nation states) involved in the situation, usually the riparians, though other key national actors may be added if seemingly essential. It has two basic phases: 1) modeling each of the actors involved and 2) modeling the power relations existing among these actors. For each actor, three basic "maps" are prepared: 1) a cognitive map, 2) a motivational map, and 3) a "meta-map."

The cognitive map basically portrays how the given actor sees things relevant to the water situation. It shows what cognitions about water and other relevant matters such as national power are linked together. Thus, one can enter the cognitive map at any point and trace the conclusions that follow for the particular actor. For example, if the actor sees that a riparian is suffering a drought, what will that imply? If it learns that a dam it wishes to build will cost twice what had been estimated, what implications follow? If it reduces the river's flow to its downstream riparian by one quarter, what consequences are likely? The cognitive map portrays the actor's understanding of such events and their consequences.

The motivational map portrays the configuration of the actor's values and goals that relate to water resources and events. The cognitive map indicates what factual implications perceived events are likely to have in the eyes of the actor; the motivational map indicates what value significance that anticipated chain of events has for the actor. Does it matter? If so, how much? Is it worth trying to do something about the likely event--to try to change or encourage it? The motivational map portrays the evaluative reaction to the events portrayed by the cognitive map.

While working on these two basic orientational maps, we realized that a third map, which we labeled a "meta-map," was necessary for a true simulation. This map takes news reports such as appear in standard dispatches and, first, translates them into language suitable for the simulation. Then it poses the elementary question of whether the actor will attend to them or not. If that is answered affirmatively, the map highlights the specific cognitive elements in the cognitive map that will be initially activated by the event--which cognitions in the cognitive map will be highlighted first.

Thus, the overall process for a particular actor will be that some external event occurs and is fed into the actor's meta-map. It decides if the actor will attend to it or not, and if it does, which cognitions will be initially affected. Once entry into the cognitive map is thus made, the implications of the event are worked out according to the actor's cognitive map, until a final understanding of the implications of the event is reached. Once that is done, action moves to the motivational map to determine whether and how much the actor cares about the factual situation presented by the cognitive map. If the actor cares enough so that a designated action threshhold is crossed--i.e., the actor may want to try to do something about the situation--then there is a return to the cognitive map to consider possible actions and their implications. The results of this process are then fed again to the motivational map to evaluate whether any actions are worth

undertaking--their costs and benefits. If more than one is worth undertaking, that with the best cost/benefit ratio is selected.

After the given actor determines to engage in a certain action and does so, that is fed as an event to the meta-maps of the other actors in accordance with the presumed patterns of power and communication. They, in turn, go through the same process, leading to some action or else to inaction on their part. These actions (and some inactions) get fed back to other actors in the system, and so the process continues until rampant escalation, a stable new equilibrium, or a damping out of the interactions occurs.

Although we have made considerable early progress in the development of this type of simulation, we are by no means finished and some difficult problems still remain. If the work can be completed, we believe that it could prove a valuable tool for gaining additional insight into this grave and tantalizing problem of conflict and cooperation over transnational river systems.

Conclusion

The chief assertion of this essay has been that explanation and prediction of conflict and cooperation in transnational river basins requires theory based upon a fine-grained understanding of both the characteristics of water as a scarce resource and the crucial aspects of power, though some useful "models" and simulations can guide rough judgments prior to more focused analyses.

Water as a resource has four primary characteristics of political significance: extreme importance, scarcity, maldistribution, and being shared. These characteristics make internecine conflict over water more likely than similar conflict over other resources. Moreover, tendencies toward water conflict are seriously exacerbated by rampant population growth and water-wasteful economic development. A national and international "power shortage," in the sense of an inability to control these two world trends, makes the problem even more alarming. To understand the likelihood of conflict or cooperation over water, an appropriate body of predictive theory must be developed.

A necessary step in the creation of such theory is clarification of the concepts of conflict and cooperation. Conflict can be regarded as existing when an actor attempts to exert power over another actor to overcome that actor's perceived blockage of the first actor's goals and faces significant intentional resistance. Cooperation refers to coordination of behavior among actors to realize at least some common goals. It is also useful to distinguish three basic phases of conflict: conflict formation, conflict processes, and conflict resolution. Current understandings of conflict frequently refer to one of these phases rather than the to phenomenon as a whole.

Just as domestic water conflicts are often resolved by legal processes, it might be assumed that international water disputes could be resolved by international law. Unfortunately, international law is in a weaker position regarding transnational river basins than in other areas, having neither established institutions nor established doctrine.

An initial contribution to the development of predictive theory covering transnational river politics might emerge from existing typologies of conflict. Examination shows, however, that most ~~of these~~ typologies of conflict are too limited to handle the multifaceted aspects of water conflicts.

A "profile" of conflict features was suggested as an improvement, but the nature and implications of profile patterns have yet to be worked out.

Next, we turned to consideration of the political contributions of various "models" of transnational river basin interactions. Catastrophe theory, game theory, Pareto admissibility, negotiation models (ADR, PIN) and others were evaluated. Although each of these is useful for certain purposes, none really offered much help for a predictive theory of water conflict. A very rough, three-element predictive model of the potential for severe conflict among riparians was then presented, the three elements being 1) the importance of the water (or hydroproject) to the nation, 2) its relative military power and 3) its riparian position. The model postulates that the most conflict-prone situation occurs when the downstream riparian is most powerful and has the strongest interest in the water. The most stable situation is when the upstream riparian is most powerful and has the least interest in the water.

To obtain a more confident and precise understanding of transnational water conflict and cooperation, fine-grained power analysis is required. A full adumbration of power analysis was not possible, but several illustrative topics were presented, including consideration of actors, motivations, cognitions, power structures and the simulation of riparian power conflicts. Using these concepts, various observations and hypotheses about transnational water conflicts were suggested. Systematic research along these lines has the prospect of providing a valid, predictive theory that would be of great value to policy-making, though the task will be neither quick nor easy.

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